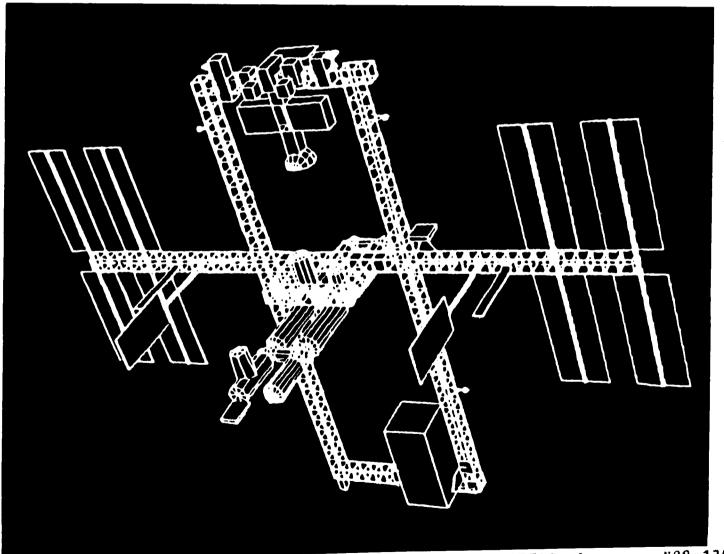


# **Space Station Systems**

NASA SP-7056(06) July 1988

A Bibliography with Indexes



(NASA-SP-7056 (C6)) SPACE STATION SYSTEMS: A EIBLICGRAPHY WITH INDEXES (SCHELEMENT 6) (NASA) 294 P CSCL 22B

N89-13459

Unclas 00/18 0168477

# SPACE STATION SYSTEMS

### **A BIBLIOGRAPHY** WITH INDEXES

### Supplement 6

Compiled by Technical Library Branch and Edited by Space Station Office NASA Langley Research Center Hampton, Virginia

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system between July 1 and December 31, 1987 in

- Scientific and Technical Aerospace Reports (STAR)
- · International Aerospace Abstracts (IAA).

### NOTE TO AUTHORS OF PROSPECTIVE ENTRIES:

The compilation of this bibliography results from a complete search of the STAR and IAA files. Many times a report or article is not identified because either the title, abstract, or key words did not contain appropriate words for the search. A number of words are used, but to best insure that your work is included in the bibliography, use the words Space Station Systems somewhere in your title or abstract, or include them as a key word.

This supplement is available from the National Technical Information Service (NTIS), Springfield , Virginia 22161 at the price code A13.

### INTRODUCTION

This bibliography is designed to be helpful to the researchers, designers, and managers engaged in the design and development of technology, configurations, and procedures that enhance efficiencies of current and future versions of a Space Station.

This literature survey lists 1,133 reports, articles and other documents announced between July 1, 1987 and December 31, 1987 in *Scientific and Technical Aerospace Reports* (STAR), and International Aerospace Abstracts (IAA).

The coverage includes documents that define major systems and subsystems, servicing and support requirements, procedures and operations, and missions for the current and future Space Station. In addition, analytical and experimental techniques and mathematical models required to investigate the different systems/subsystems and conduct trade studies of different configurations, designs, and scenarios are included. A general category completes the list of subjects addressed by this document.

The selected items are grouped into categories as listed in the Table of Contents with notes regarding the scope of each category. These categories were especially selected for this publication and differ from those normally found in *STAR* and *IAA*.

Each entry consists of a standard bibliographic citation accompanied by an abstract, where available, and appears with the original accession numbers from the respective announcement journals.

Under each of the categories, the entries are presented in one of two groups that appear in the following order:

- (1) IAA entries identified by accession number series A87-10,000 in ascending accession number order:
- (2) STAR entries identified by accession number series N87-10,000 in ascending accession number order.

After the abstract section there are seven indexes—subject, personal author, corporate source, foreign technology, contract number, report number, and accession number.

A companion continuing bibliography, "Technology for Large Space Structures," is available as NASA SP-7046.

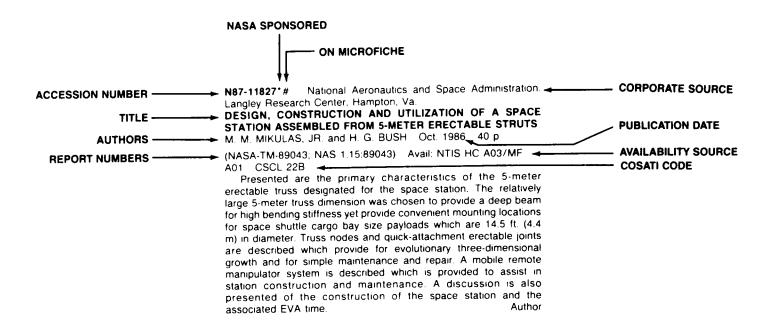
Robert E. Satterthwaite, Space Station Office Sue K. Seward, Technical Library Branch

# **TABLE OF CONTENTS**

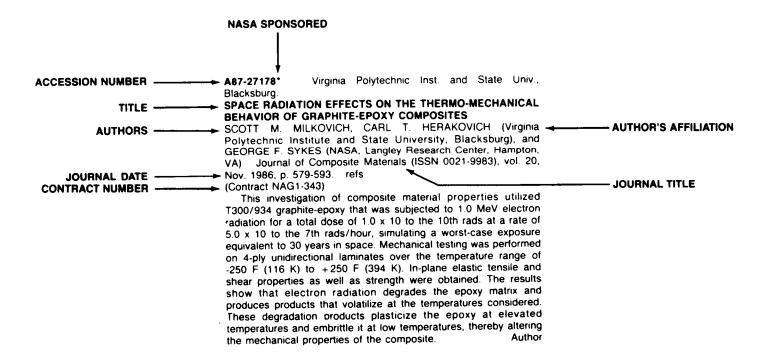
	Page
Category 01 Systems Includes system requirements for proposed missions, mission models, overall conceptual configuration and arrangement studies; systems analyses for future required technology; and identification and description of technology developments and experiments for the elements of a complete Space Station system.	1
Category 02 Models, Analytical Design Techniques, and Environmental Data Includes descriptions of computerized interactive systems design and development techniques, computer codes, internal and external environmental models and data.	5
Category 03 Structural Concepts Includes analyses and descriptions of different Space Station structural concepts, arrangements, testing, methods of construction and/or manufacturing and specific rotary joints, structural nodes, and columns.	11
Category 04 Thermal Control Includes descriptions of analytical techniques, passive and active thermal control techniques, external and internal thermal experiments and analyses and trade studies of thermal requirements.	40
Category 05 Environmental Control and Life Support Systems Includes description of analytical techniques and models, trade studies of technologies, subsystems, support strategies, and experiments for internal and external environmental control and protection, life support systems, human factors, life sciences and safety.	46
Category 06 Dynamics and Controls Includes descriptions of analytical techniques and computer codes, trade studies, requirements and decriptions of orbit maintenance systems, rigid and flexible body attitude sensing systems and controls such as momentum wheels and/or propulsive schemes.	54
Category 07 Power Includes descriptions of analyses, systems, and trade studies of electric power generation, storage, conditioning and distribution.	74
Category 08 Electronics Includes descriptions of analytical techniques, analyses, systems, and requirements for internal and external communications, electronics, sensors for position and systems monitoring and antennas.	84
Category 09 Propulsion/Fluid Management Includes descriptions, analyses, and subsystem requirements for propellant/fluid management, and propulsion systems for attitude control and orbit maintenance and transfer for the station and supporting elements such as the OMV and OTV.	88
Category 10 Mechanisms, Automation, and Artificial Intelligence Includes descriptions of simulations, models, analytical techniques, and requirements for remote, automated and robotic mechanical systems.	99
Category 11 Materials Includes mechanical properties of materials, and descriptions and analyses of different structural materials, films, coatings, bonding materials, and descriptions of the effects of natural and induced space opvironments.	105

Includes descriptions, requirements, and trade studies of different information and data system hardware and software, languages, architecture, processing and storage requirements for managing and monitoring of different systems and subsystems.	111
Includes descriptions of simulations, analyses, trade studies, and requirements for safe efficient procedures, facilities, and support equipment on the ground and in space for processing, servicing, verification and checkput of cargo and equipment.	118
Category 14 Growth Includes descriptions of scenarios, analyses and system technology requirements for the evolutionary growth of the Space Station system.	120
Category 15 Missions, Tethers, and Platforms Includes descriptions and requirements of missions and tethers onboard the Space Station and platforms that are either co-orbiting with the Space Station, in polar orbit, or in geosynchronous orbit and which are part of the Space Station system.	121
Category 16 Operations Support  Includes descriptions of models, analyses and trade studies of maneuvers, performance, support, and EVA and/or IVA servicing requirements of Space Station systems such as the OMV and OTV, and experiments.	132
Category 17 Space Environment Includes description of the space environment and effects on Space Station subsystems. Includes requirements of Space Station to accommodate this environment.	138
Category 18 International Includes descriptions, interfaces and requirements of international payload systems, subsystems and modules considered part of the Space Station system and other international Space Station activities such as the Soviet Salyut.	143
Category 19 Support Spacecraft Includes design, analysis, requirements, trade studies and simulations of Space Station support spacecraft including the orbital transfer vehicle (OTV) and the orbital maneuvering vehicle (OMV).	160
Catefory 20 Life Sciences/Human Factors/Safety Includes studies, models, planning, analyses and simulations for biological and medical laboratories, habitability issues for the performance and well-being of the crew, and crew rescue.	162
Includes descriptions, analyses, trade studies, commercial opportunities, published proceedings, seminars, hearings, historical summaries, policy speeches and statements that have not previously been included.	166
Subject Index	<b>A-1</b>
Personal Author index	D- 1
Corporate Source Index	C-1
Foreign Technology Index	ו-ט
Contract Number Index	E-1
Report Number Index	F-7
Accession Number Index	G-1

#### TYPICAL REPORT CITATION AND ABSTRACT



#### TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT



# SPACE STATION SYSTEMS

A Bibliography (Suppl. 6)

**JULY 1988** 

#### 01

#### **SYSTEMS**

Includes system requirements for proposed missions, mission models, overall conceptual configuration and arrangement studies; systems analyses for future required technology; and identification and description of technology developments and experiments for the elements of a complete Space Station system.

#### A87-32116

#### A QUESTION OF GRAVITY

RAY SPANGENBURG and DIANE MOSER Space World (ISSN 0038-6332), vol. X-2-278, Feb. 1987, p. 8-11.

Artificial gravity is the only currently known method for avoiding the physioogical effects of long-term weightlessness which Space Station and Mars mission crew would encounter. Techniques such as exercise and lower body negative pressure devices have not proven sufficiently effective. Vestibular excitement by the Coriolis force rules out use of a rotating room that could be contained in spaceships. A leading alternative for a Mars mission is to have a nuclear reactor tethered to a spacecraft a kilometer away. The entire configuration would rotate about its center, providing artificial gravity and minimizing the Coriolis force at the populated end. Ground-based bedrest and rotating room and proposed Space Station co-orbiting variable gravity experiments which may determine the minimal artificial gravity needed to avoid the effects of prolonged weightlessness are summarized.

A87-32277\* National Aeronautics and Space Administration, Washington, D.C.

# NASA'S SPACE PROGRAM - SPACE STATION: A STATUS REPORT AND A VIEW OF ITS VALUE FOR SPACE SCIENCE

DAVID C. BLACK (NASA, Office of Space Station, Washington, DC) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 1. Tokyo, AGNE Publishing, Inc., 1986, p. 3-6.

The current status of the Space Station program and the proposed configuration, operation, and evolution of the Space Station are described. The Space Station is to be composed of a manned base and two unmanned platforms; the configuration of the Station is dual keel, and the baseline system includes a hybrid power system with photovoltaics providing 25 kW and solar dynamics providing 50 kW. International participation in the development and use of the Space Station, in particular the design of the pressurized modules, is discussed. Intended scientific uses of the Space Station Complex are considered.

#### A87-32625

#### **COMMERCIAL US TRANSFER VEHICLE OVERVIEW**

J. W. WINCHELL and R. L. HUSS (McDonnell Douglas Astronautics Co., Huntington Beach, CA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 13-16, 1986. 13 p.

(SAE PAPER 861764)

A survey is presented of the design and operational status and intended or existing missions for apogee kick motors for launch from the Orbiter bay. Attention is also given to the associated

hardware for interfacing and propelling the payloads from the bay. The PAM-D, -DII, and -A upper stage motors are described, with their payload boost capabilities of 1500-4300 lb to GEO. Features of the solid-fueled Transfer Orbit Stage, based on the IUS, and the liquid bipropellant-fueled Apogee and Maneuvering Stage, which can lift from 3000-5600 lb to GEO, respectively, are also delineated. The discussion also covers the liquid-fueled Leasat apogee motor, the solid-fueled GEO injection motor of the Shuttle Compatible Orbit Transfer Subsystem (4100-5900 lb), and the IUS (5000 lb) and Centaur (10,000 lb) systems. Government-industry cooperation to encourage the continued development of the industrial base to continue and expand production and use of upper stage vehicles is noted.

#### A87-32802

# STABILITY IN THE RELATIVE EQUILIBRIUM POSITIONS OF SPACE STATIONS AT TRIANGULAR LIBRATION POINTS IN THE PHOTOGRAVITATIONAL THREE-BODY PROBLEM

A. A. PEREZHOGIN (Kosmicheskie Issledovaniia, vol. 23, Sept.-Oct. 1985, p. 676-683) Cosmic Research (ISSN 0010-9525), vol. 23, no. 5, March 1986, p. 528-533. Translation. refs

A study has been made regarding the selection of stable equilibrium orientations for a space station using solar sails for control and gravitational equilibrium for anchoring at specific points in space. The study considers the generalized, photogravitational, restricted, circular three-body problem. Passively gravitating space stations are modeled by solid objects. It is assumed that the sail area of the station (the ratio of cross section to mass) does not depend on the station's orientation. Two dynamically equivalent relative equilibrium positions for the station are found from the conditions of steady-state change in the station's potential energy. The sufficient conditions for stability of the equilibrium solutions are obtained.

#### A87-37963

#### SPACE SHUTTLE FLIGHT RATES AND UTILIZATION

Space Policy (ISSN 0265-9646), vol. 3, Feb. 1987, p. 5-9. Previously announced in STAR as N87-14368.

Possible space shuttle flight rates and their implications in respect to payloads and the need for expendable launch vehicles are assessed.

#### A87-40051

# U.S. NATIONAL CONGRESS OF APPLIED MECHANICS, 10TH, UNIVERSITY OF TEXAS, AUSTIN, JUNE 16-20, 1986, PROCEEDINGS

J. PARKER LAMB, ED. (Texas, University, Austin) Congress organized by the National Academy of Sciences and National Academy of Engineering; Supported by NSF, U.S. Navy, Dow Chemical Co., et al. New York, American Society of Mechanical Engineers, 1987, 558 p. For individual items see A87-40052 to A87-40085.

(AD-A181962)

Recent advances in applied mechanics are addressed in reviews and reports of theoretical and experimental investigations. Topics examined include cellular biomechanics, computational fluid mechanics, continuum damage mechanics, dispersed systems, the dynamic stability of structures, experimental methods in mechanics, and fluid mechanics in material processing. Consideration is given to manufacturing processes, material modeling for fracture, the

mechanics of particulate media, NDE, space structures, stability and the transition to turbulence, temporal and spatial chaos, and unsteady aerodynamics.

A87-40351

EASCON '86; PROCEEDINGS OF THE NINETEENTH ANNUAL ELECTRONICS AND AEROSPACE SYSTEMS CONFERENCE, WASHINGTON, DC, SEPT. 8-10, 1986

Conference sponsored by IEEE, Armed Forces Communications and Electronics Association, and National Space Club. New York, Institute of Electrical and Electronics Engineers, Inc., 1986, 296 p. For individual items see A87-40352 to A87-40381.

Papers are presented on civilian space programs, military space programs, the status of the Space Station, and satellite communications in the fiber era. Topics discussed include remote sensing programs, Space Station communications and data management, communications satellite systems, and advanced software and microelectronics technology. Consideration is given to Space Station experiments, near-term science missions, communications technology, very small aperture terminals, future science missions, and avionics, robotic, and support technology. ïF.

A87-45523 ANTENNA SYSTEMS AND RF COVERAGE FOR THE SPACE

Y. C. LOH, K. W. SHELTON, and K. TU (Lockheed Engineering and Management Services Co., Inc., Houston, TX) IN: GLÖBECOM '86 - Global Telecommunications Conference, Houston, TX, Dec. 1-4, 1986, Conference Record. Volume 2 . New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 838-842.

This paper presents some of the results on the radio frequency (RF) coverage analysis of the Space Station (SS) to Tracking Data Relay Satellite System (TDRSS) links and the Multiple-Access (MA) links. The antenna systems for both types of communication links were identified by considering typical operational scenarios, different types of services needed, and the architecture of the communication system. The paper describes the obscuration analysis tools for the placement of the antennas and an optimization procedure used to design the MA near range antenna system.

Author

A87-48601# AUTOMATED SOFTWARE PRODUCTION

R. J. LAUBER (Stuttgart, Universitaet, West Germany) AIAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 8 p.

(AIAA PAPER 87-2219)

The automation-based software paradigm which forms the basis of the EPOS system is discussed, and it is suggested that such a paradigm may alleviate many problems inherent in software systems such as the embedded software systems required for the Space Station. Automated code generation features are discussed using an Ada generator as an example. The need for automated software verification is emphasized, and various approaches to software verification and validation are considered. It is suggested that software reusability may be a powerful tool for improving reliability, as well as improving software productivity.

A87-53082\* United Technologies Corp., East Hartford, Conn. THE HUMAN QUEST IN SPACE; PROCEEDINGS OF THE TWENTY-FOURTH GODDARD MEMORIAL SYMPOSIUM,

GREENBELT, MD, MAR. 20, 21, 1986
GERALD L. BURDETT, ED. (United Technologies Corp., Hartford, CT) and GERALD A. SOFFEN, ED. (NASA, Goddard Space Flight Center, Greenbelt, MD) Symposium organized by AAS; Sponsored by AAS, AIAA, National Space Club, and National Space Institute. San Diego, CA, Univelt, Inc. (Science and Technology Series. Volume 65), 1987, 310 p. For individual items see A87-53083 to A87-53093.

Papers are presented on the Space Station, materials

processing in space, the status of space remote sensing, the evolution of space infrastructure, and the NASA Teacher Program. Topics discussed include visionary technologies, the effect of intelligent machines on space operations, future information technology, and the role of nuclear power in future space missions. Consideration is given to the role of humans in space exploration; medical problems associated with long-duration space flights; lunar and Martian settlements, and Biosphere II (the closed ecology project).

A87-53086 TECHNOLOGY PROJECTIONS AND SPACE SYSTEMS OPPORTUNITIES FOR THE 2000-2030 TIME PERIOD

ROBERT A. DAVIS (Aerospace Corp., Los Angeles, CA) The human quest in space; Proceedings of the Twenty-fourth Goddard Memorial Symposium, Greenbelt, MD, Mar. 20, 21, 1986 San Diego, CA, Univelt, Inc., 1987, p. 75-120; Discussion, p. 121-123. refs

(AAS PAPER 86-109)

Some of the space system technologies necessary for civil space projects in the future (2000-2030), which were included in a report prepared for the American Institute of Aeronautics and Astronautics for submittal to the National Space Commission, are described. The effects of NASA and DOD space system technology planning, the SDI program, and National Space Strategy on space systems and technology developments are examined. Space transportation, the establishment of a Space Station, the role of government in space commercialization, international competition in space, joint space missions, and space activities for enhancing global habitability are discussed. Consideration is given to the benefits space systems with earth-oriented applications can provide to civilian communications, navigation and location, earth observation, and space manufacturing; missions to the moon, Mars, comets, asteroids, other planets, and the Galaxy; the next-generation of space transportation systems and mission control; and the construction and maintenance of space infrastructure.

National Aeronautics and Space Administration, N87-20356\*# Washington, D.C. Materials and Structures Div.
FUTURE TRENDS IN SPACECRAFT DESIGN AND

QUALIFICATION

SAMUEL L. VENNERI, BRANTLEY R. HANKS (National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.), and LARRY D. PINSON In AGARD Mechanical Qualification of Large Flexible Spacecraft Structures 9 p 1986

Avail: NTIS HC A12/MF A01 CSCL 22A

Material and structures issues that must be resolved in order to develop the technology data base needed to design and qualify the next generation of large flexible spacecraft are discussed. This invoves the development of new ground test and analysis methods and the conduct of appropriate instrumented in-space flight experiments for final verification. A review of present understanding of material behavior in the space environment and identification of future needs is presented. The dynamic verification and subsequent qualification of a spacecraft structure currently rely heavily on ground-based tests, coupled with the verified analysis model. Future space structures, such as large antennas, Space Station and other large platforms, will be of sizes difficult to test using current ground test methods. In addition to size, other complex factors, such as low natural frequencies, lightweight construction and many structural joints, will also contribute significant problems to the test and qualification process in an Earth-gravity environment. These large spacecraft will also require new technology for controlling the configuration and dynamic deformations of the structures. Future trend in large flexible structures will also involve long-life design missions (10 to 20 years). In low earth orbit (LEO), materials will be subjected to repeated thermal cycles, ultraviolet radiation, atomic oxygen and vacuum. For high orbits such as geo-synchronous earth orbit (GEO), the materials will also be subjected to large doses of high energy electrons and protons. Understanding degradation and material stability over long-mission time periods will confront the designer with many issues that are unresolved today.

N87-20682\*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. AERO-ASSISTED ORBITAL TRANSFER VEHICLE (AOTV)

OLIVER HILL In NASA. Marshall Space Flight Center Upper and Middle Atmospheric Density Modeling Requirements for Spacecraft Design and Operations p 203-219 Feb. 1987 Avail: NTIS HC A13/MF A01 CSCL 04A

The AOTV will make use of the atmosphere to provide braking on return from a planetary mission or geosynchronous orbit. The minimum altitude for aerobraking is typically 255,000 ft at the equator. Time of the braking maneuver is typically 480 sec from 400,000 ft to 255,000 ft and back out - about 8 min. The problem is to design a control system that will be able to handle density irregularities such as those that have shown up in shuttle data near 280,000 ft. To obtain data, one has to use model-produced statistics or information obtained during the atmospheric transit time. The Global Reference Atmosphere Model (GRAM) appears to bracket the shuttle data, but it is not clear that the statistics are correct. The model-data exhibits strong density shears over small step size that are probably an artifact.

N87-23680# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

A SYSTEMS ANALYSIS OF EMERGENCY ESCAPE AND RECOVERY SYSTEMS FOR THE US SPACE STATION M.S. Thesis

BRIAN K. KELLY Dec. 1986 115 p (AD-A179233; AFIT/GSO/AA/86D-5) Avail: NTIS HC A06/MF A01 CSCL 06G

Recent designs for the U.S. manned space station have crews on board the space station without any means of emergency escape for periods of up to 90 days. This investigation analyzes emergency escape recovery systems for use on the space station in an effort to find the best escape device. Initially, the objectives to be met by an effective escape device were identified along with the corresponding measures of effectiveness (MOE) for each objective. Fifteen alternative escape systems were found that could be used on the manned core portion of the space station complex. A preliminary analysis reduced the number of alternatives considered for more detailed analysis to six. These final six, The Maneuverable Entry Research Vehicle (MERV), Emergency Astronaut Re-entry Parachute System, Manned Orbital Escape System (MOSES), MOOSE (Man out of Space Easiest), and Apollo Command Module, were compared on the basis of their calculated MOEs using multi-attribute utility theory. The overall utilities for each of the final six alternatives were calculated for two crew sizes, 3-man and 8-man. MOSES was found to consistently rate the highest overall utility for both manning scenarios. The next best alternative was the Apollo Command Module.

N87-24500\*# National Aeronautics and Space Administration, Washington, D.C.

## LARGE SPACE SYSTEMS TECHNOLOGY AND REQUIREMENTS

JAMES M. ROMERO In NASA-Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 p 665-673 Jun. 1987

Avail: NTIS HC A14/MF A01 CSCL 22B

Only viewgraphs of this presentation are shown. Outlined are NASA's space emphasis, state of technology, space R&D funding trend and civil space technology initiative. Also given are Control/Structures Interaction Technology (CSTI) focus, program focus on driver missions, in-space technology experiments, and in-space R&T approach.

N87-26063\*# General Electric Co., Philadelphia, Pa. Re-Entry Systems Operations.

SYSTEM TECHNOLOGY ANALYSIS OF AEROASSISTED ORBITAL TRANSFER VEHICLES. MODERATE LIFT/DRAG (0.75-1.5): VOLUME 1A, PART 2: EXECUTIVE SUMMARY, PHASE 2 Final Report

Aug. 1985 33 p (Contract NAS8-35096)

(NASA-CR-179140; NAS 1.26:179140;

REPT-85SDS2184-VOL-1A-PT-2) Avail: NTIS HC A03/MF A01 CSCL 22A

Significant achievements and activities of Phase 2 of a study to assess aeroassisted orbit transfer vehicle (AOTV) system technology are summarized. Phase 2 was directed towards identification and prioritization of technology payoffs of representative space based mid lift/drag ratio (L/D) AOTV's and the cryofueled propulsion subsystem - configuration interactions. Enhancing technology areas were identified which could provide substantial transport cost reduction. These include: (1) improved lifetime of storable propellant engines; (2) avionics weight reduction; (3) external thermal protection system weight reduction; (4) decrease of uncertainties in aerodynamic and aerothermodynamic performance; electrical power subsystem weight reduction due to incorporation of advanced materials; and (6) structural shell weight reduction. Results indicated that advanced aerothermodynamic methodology and aft end configuring may provide an enlarged allowable zone for engine nozzle protrusions into the separated flow region. Payload manifesting and non-hydrogen propellant manifesting at the space station is recommended.

N87-26064\*# General Electric Co., Philadelphia, Pa. Re-Entry Systems Operations.

SYSTEM TECHNOLOGY ANALYSIS OF AEROASSISTED ORBITAL TRANSFER VEHICLES: MODERATE LIFT/DRAG (0.75-1.5). VOLUME 3: COST ESTIMATES AND WORK BREAKDOWN STRUCTURE/DICTIONARY, PHASE 1 AND 2 Final Report

Aug. 1985 44 p

(Contract NAS8-35096)

Technology payoffs of representative ground based (Phase 1) and space based (Phase 2) mid lift/drag ratio aeroassisted orbit transfer vehicles (AOTV) were assessed and prioritized. A narrative summary of the cost estimates and work breakdown structure/dictionary for both study phases is presented. Costs were estimated using the Grumman Space Programs Algorithm for Cost Estimating (SPACE) computer program and results are given for four AOTV configurations. The work breakdown structure follows the standard of the joint government/industry Space Systems Cost Analysis Group (SSCAG). A table is provided which shows cost estimates for each work breakdown structure element.

N87-26065\*# General Electric Co., Philadelphia, Pa. Re-Entry Systems Operations.

SYSTEM TECHNOLOGY ANALYSIS OF AEROASSISTED ORBITAL TRANSFER VEHICLES: MODERATE LIFT/DRAG (0.75-1.5). VOLUME 2: SUPPORTING RESEARCH AND TECHNOLOGY REPORT, PHASE 1 AND 2 Final Report

Aug. 1985 41 p

(Contract NAS8-35096)

(NASA-CR-179143; NAS 1.26:179143; REPT-85SDS2184-VOL-2) Avail: NTIS HC A03/MF A01 CSCL 22B

Technology payoffs of representative ground based (Phase 1) and space based (Phase 2) mid lift/drag ratio (L/D) aeroassisted orbit transfer vehicles (AOTV) were assessed and prioritized. The methodology employed to generate technology payoffs, the major payoffs identified, the urgency of the technology effort required, and the technology plans suggested are summarized for both study phases. Technology issues concerning aerodynamics, aerothermodynamics, thermal protection, propulsion, and guidance, navigation and control are addressed.

M.G.

N87-26066\*# General Electric Co., Philadelphia, Pa. Re-Entry Systems Operations.

SYSTEM TECHNOLOGY ANALYSIS OF AEROASSISTED ORBITAL TRANSFER VEHICLES: MODERATE LIFT/DRAG (0.75-1.5), VOLUME 1B, PART 1, STUDY RESULTS Final Report

Aug. 1985 228 p (Contract NAS8-35096)

(NASA-CR-179141; NAS 1.26:179141;

REPORT-85SDS2184-VOL-1B-PT-1) Avail: NTIS HC A11/MF

CSCL 22B

Significant performance benefits can be realized via aerodynamic breaking and/or aerodynamic maneuvering on return from higher altitude orbits to low Earth orbit. This approach substantially reduces the mission propellant requirements by using the aerodynamic drag, D, to brake the vehicle to near circular velocity and the aerodynamic lift, L, to null out accumulated errors as well as change the orbital inclination to that required for rendezous with the Space Shuttle Orbiter. A study was completed where broad concept evaluations were performed and the technology requirements and sensitivities for aeroassisted Orbital Transfer Vehicles (AOTVs) over a range of vehicle hypersonic L/D from 0.75 to 1.5 were systematically identified and assessed. The AOTV is capable of evolving from an initial delivery only system to one eventually capable of supporting manned roundtrip missions to geosynchronous orbit. Concept screenings were conducted on numerous configurations spanning the L/D = 0.75 to 1.5 range, and several with attractive features were identified. Initial payload capability was evaluated for a baseline of delivery to GEO, six hour polar, and Molniya orbits with return and recovery of the AOTV at LEO. Evolutionary payload requirements that were assessed include a GEO servicing mission and a manned GEO mission.

N87-26067\*# General Electric Co., Philadelphia, Pa. Re-Entry Systems Operations.

SYSTEM TECHNOLOGY ANALYSIS OF AEROASSISTED ORBITAL TRANSFER VEHICLES: MODERATE LIFT/DRAG (0.75-1.5), VOLUME 1B, PART 2, STUDY RESULTS Final Report

Aug. 1985 250 p (Contract NAS8-35096) (NASA-CR-179142; NAS 1.26:179142; REPT-85SDS2184-VOL-1B-PT-2) Avail: NTIS HC A11/MF A01

CSCL 22B A complete compilation of the results from Phase 2 of a study to identify and prioritize the technology payoffs of representative space based mid lift/drag ratio (L/D) aeroassisted orbit transfer vehicles (AOTV) and the cryofueled propulsion subsystem configuration interactions is presented. Several combinations of basing and launch vehicle options, staging scenarios, missions (delivery, servicing, or manned round trip), and target orbits were considered. Space basing of an AOTV opens up numerous configuration opportunities. The size can exceed the launch vehicle cargo bay envelope by resorting to orbital assembly and the AOTV weight can exceed the launch vehicle capability. With the absence of fully fueled tanks during a ground based launch much lighter gossamer type structures are possible that may result in performance gains. At the Space Station, payload rearranging or manifesting may prove attractive. Several major conclusions regarding aerothermodynamics, aerodynamics, payload manifesting, the propulsion subsystem, and systems issues are discussed.

National Aeronautics and Space Administration, N87-26073\* Washington, D.C.

SPACE STATION SYSTEMS: A BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 4)

May 1987 220 p

(NASA-SP-7056(04); NAS 1.21:7056(04)) Avail: NTIS HC A10

This bibliography lists 832 reports, articles, and other documents introduced into the NASA scientific and technical information system between July 1, 1986 and December 31, 1986. Its purpose

is to provide helpful information to the researcher, manager, and designer in technology development and mission design according to system, interactive analysis and design, structural and thermal analysis and design, structural concepts and control systems, electronics, advanced materials, assembly concepts, propulsion, and solar power satellite systems. The coverage includes documents that define major systems and subsystems, servicing and support requirements, procedures and operations, and missions for the current and future space station.

#### N87-26185\*# Aerospace Corp., El Segundo, Calif. LABORATORY STUDIES OF ATOMIC OXYGEN REACTIONS WITH SOLIDS Abstract Only

GRAHAM S. ARNOLD and DANIEL R. PEPLINSKI Propulsion Lab., Proceedings of the NASA Workshop on Atomic Oxygen Effects p 103 1 Jun. 1987

Avail: NTIS HC A09/MF A01 CSCL 07D

Atomic beam experiments were performed to investigate the rate of atomic oxygen etching of carbon and polyimide films. The main emphasis of these experiments was on gaining an understanding of the role of atomic oxygen translational energy and substrate temperature in promoting the reactions. The experimental facility and techniques are described and results Author reviewed.

N87-28583\*# Boeing Aerospace Co., Seattle, Wash. SPACE STATION INTEGRATED WALL DESIGN AND PENETRATION DAMAGE CONTROL. TASK 4: IMPACT **DETECTION/LOCATION SYSTEM Final Report** 

J. M. NELSON and B. M. LEMPRIERE Jul. 1987 (Contract NAS8-36426)

(NASA-CR-179167; NAS 1.26:179167; D180-30550-3) Avail: NTIS HC A04/MF A01 CSCL 22B

A program to develop a methodology is documented for detecting and locating meteoroid and debris impacts and penetrations of a wall configuration currently specified for use on space station. Testing consisted of penetrating and non-penetrating hypervelocity impacts on single and dual plate test configurations, including a prototype 1.22 m x 2.44 m x 3.56 mm (4 ft x 8 ft x 0.140 in) aluminum waffle grid backwall with multilayer insulation and a 0.063-in shield. Acoustic data were gathered with transducers and associated data acquisition systems and stored for later analysis with a multichannel digitizer. Preliminary analysis of test data included sensor evaluation, impact repeatability, first waveform arrival, and Fourier spectral analysis.

National Aeronautics and Space Administration. N87-29163\*# Goddard Space Flight Center, Greenbelt, Md.

USER DATA MANAGEMENT

In NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, Volume 2 9 p Avail: NTIS HC A17/MF A01 CSCL 09B

The primary objective is to identify, develop, and demonstrate key data management technologies to support user access to Space Station data. To accomplish this objective, there are several technical challenges which must be addressed. The first is how to provide routine customer access to high volume, dynamic and distributed data bases. This access will encompass the functions of mission and payload planning and operations, data processing and analysis, and data archive and distribution. Secondly, there must be some analysis of architectures for handling high volume data streams like those expected from the Space Station. This analysis will examine the use of packetized versus non-packetized data formats, modular expansion capabilities, real-time versus non-real-time data processing, and the interfaces and architecture required to support telescience operations. The task will also determine benchmarks of performance capabilities for technology operations, such as varied data base structures, data access procedures, distributed data base design, and data base machines. Author Information is provided here in outline form.

### 02 MODELS. ANALYTICAL DESIGN TECHNIQUES, AND ENVIRONMENTAL DATA

N87-29164\*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ADVANCED SOFTWARE TOOLS SPACE STATION FOCUSED TECHNOLOGY

ROBERT W. NELSON In NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, Volume 2 11 p Aug. 1985

Avail: NTIS HC A17/MF A01 CSCL 09B

Information is given in outline form on advanced software tools for the Space Station data management system. The Space Station data management system is identified as a highly distributed system with payload users controlling experiments and processing payload data from home facilities. Ř.J.E.

N87-29583# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.

DESIGN OF A MIXED FLEET TRANSPORTATION SYSTEM TO LOW EARTH ORBIT. VOLUME 1: EXECUTIVE SUMMARY. VOLUME 2: NEAR-TERM SHUTTLE REPLACEMENT. VOLUME 3: HEAVY-LIFT CARGO VEHICLE. VOLUME 4: ADVANCED TECHNOLOGY SHUTTLE REPLACEMENT

SUSAN T. FIELDS, KEVIN D. JOHNSON, THOMAS S. NICHOLS, MICHAEL J. NOVIN, PAUL J. SHAWCROSS, BARTON E. SHOWALTER, ELI NIEWOOD, comp., CHRIS YOUNG, comp., and CHRIS PETERSON, ed. and comp. 1987 852 p Avail: NTIS HC A99/MF E03

The future of the American space program will depend on the development and choice of the next generation of launch vehicles. Future payloads may be too massive for the current Space Transportation System. Other missions may require the transportation of large crews of humans to the space station. Consequently, future launch vehicle fleets need to emphasize diversity and low cost. The design of four vehicles chosen to fulfill the future payload delivery requirements is discussed in general terms. An analysis of the cost and design of these vehicles will follow. This analysis will lead to a complete annual schedule of payload deliveries. Two different delivery programs are proposed: one strives for the lowest possible cost, and the other emphasizes the advancement of high technology in the space program.

Author

N87-29914\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SPACE ELECTROCHEMICAL RESEARCH AND TECHNOLOGY (SERT)

Sep. 1987 364 p Conference held in Cleveland, Ohio, 14-16 Apr. 1987

(NASA-CP-2484; E-3506; NAS 1.55:2484) Avail: NTIS HC A16/MF A01 CSCL 10C

The conference provided a forum to assess critical needs and technologies for the NASA electrochemical energy conversion and storage program. It was aimed at providing guidance to NASA on the appropriate direction and emphasis of that program. A series of related overviews were presented in the areas of NASA advanced mission models (space stations, low and geosynchronous Earth orbit missions, planetary missions, and space transportation). Papers were presented and workshops conducted in a variety of technical areas, including advanced rechargeables, advanced concepts, critical physical electrochemical issues, and modeling.

N87-29916\*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

LEO AND GEO MISSIONS

ENRICO MERCANTI In NASA-Lewis Research Center, Space Electrochemical Research and Technology (SERT) p 9-14 1987

Avail: NTIS HC A16/MF A01 CSCL 22A

The occurrence of the Challenger disaster in early 1986 caused a severe reevaluation of the space program. Plans already established had to be drastically revised and new plans had to be made. NASA created the Space Leadership Planning Group (SLPG) to formulate space mission plans covering a 50 year period based on Agency goals and objectives responsive to the National Commission on Space recommendations. An interim view of the status of SLPG plans for low altitude and geosynchronous missions is presented. Author

#### 02

#### MODELS, ANALYTICAL DESIGN TECHNIQUES. AND ENVIRONMENTAL DATA

Includes descriptions of computerized interactive systems design and development techniques, computer codes, internal and external environmental models and data

#### A87-29133

#### FREQUENCY DISPERSION IN THE ADMITTANCE OF THE POLYCRYSTALLINE CU2S/CDS SOLAR CELL

L. V. HMURCIK (Bridgeport, University, CT) and R. A. SERWAY (James Madison University, Harrisonburg, VA) Journal of Applied Physics (ISSN 0021-8979), vol. 61, Jan. 15, 1987, p. 756-761. Research supported by the University of Bridgeport. refs

The admittance versus frequency for the Cu2S/CdS solar cell was measured. In the dark, the dispersion fits a model of a simple Debye capacitor, with deviation due to grain-boundary scattering at low frequencies. Under illumination, the dispersion becomes a function of surface roughness. Modeled in fractal geometry, the admittance varies as (i x omega) exp m. A second term of this type occurs at high frequencies and at illuminations greater than 0.1 percent AM 1. In this case, the depletion layer extends deep into the CdS due to insufficient charge states at the interface.

Author

A87-32121\* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif. MAXIMUM LIKELIHOOD IDENTIFICATION USING AN ARRAY

**PROCESSOR** 

BANAVAR SRIDHAR (NASA, Ames Research Center, Moffett Field, CA) and JEAN-NOEL AUBRUN (Lockheed Research Laboratories. Palo Alto, CA) IEEE Control Systems Magazine (ISSN 0272-1708), vol. 7, Feb. 1987, p. 35-38. Research supported by the Lockheed Independent Research Program. refs

Maximum likelihood estimation (MLE) is a method used to calculate the parameters of a dynamic system. It can be applied to a large class of problems and has good statistical properties. The main disadvantage of the MLE method is the amount of computation required. This paper describes how the computation time can be reduced significantly by using an array processor. The estimation of the parameters of a dynamic model of the Space Station is used as an example to evaluate the method.

#### A87-32639

#### MOVER II - A COMPUTER PROGRAM FOR VERIFYING REDUCED-ORDER MODELS OF LARGE DYNAMIC SYSTEMS

J. D. CHROSTOWSKI and T. K. HASSELMAN (Engineering Mechanics Associates, Inc., Torrance, CA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 13-16, 1986. 14 p. USAF-supported research, refs (SAE PAPER 861790)

This paper introduces a computer code for model verification of linear dynamic systems. Presentation is made within the broader context of system identification, and the many alternatives available for implementing a code. Practical considerations of the system identification process are discussed first. Alternative methods are reviewed and a classification system for existing as well as nonexisting methods is proposed. Finally, a rationale for the selection of a particular modeling approach, type of measurement data, and estimation algorithm is discussed. Although MOVER II was not specifically designed for large space structures, its capabilities fulfill many of the needs now recognized as important in the verification of reduced-order models. Prior application

# 02 MODELS, ANALYTICAL DESIGN TECHNIQUES, AND ENVIRONMENTAL DATA

involving extensive use of substructuring and coordinate reduction is discussed.

#### A87-32657\* California Univ., Los Angeles. INTEGRATED CONTROL/STRUCTURE DESIGN AND **ROBUSTNESS**

A. ADAMIAN and J. S. GIBSON (California, University, Los Angeles) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 13-16, 1986. 10 p. refs (Contract JPL-957114)

(SAE PAPER 861821)

When a flexible structure is to be controlled actively, optimum performance is obtained by integrated, or simultaneous, design of the structure and the controller, as opposed to the common practice of designing the structure independently of control consideration and then designing a controller for a fixed structure. The primary design objective from the structural point of view usually is to minimize weight, while the control design objectives depend on the application. An important requirement for a practical control system is robustness with respect to uncertain plant parameters. This paper discusses simultaneous control/structure design when the overall design objective combines the weight of the structure and the robustness of the closed-loop control system. For numerical optimization, robustness is represented by the sensitivity of the closed-loop eigenvalues with respect to uncertain parameters. An example illustrates the optimal design of a flexible structure along with a robust compensator.

#### USER INTERFACE DESIGN GUIDELINES FOR EXPERT A87-33050 TROUBLESHOOTING SYSTEMS

DAVID R. EIKE, STEPHEN A. FLEGER, and ELIZABETH R. PHILLIPS (Carlow Associates, Inc., Fairfax, VA) IN: Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volume 2 . Santa Monica, CA, Human Factors Society, 1986, p. 1024-1028. refs

This paper describes the status and preliminary results of an ongoing research project to develop and validate user interface design guidelines for expert troubleshooting systems (ETS). The project is part of a larger research program to study the application of emerging user interface technologies to the design and development of user interfaces for Space Station-era systems. The project has two separate research thrusts. The first and central thrust is to develop and validate a set of human engineering guidelines for designing the user interface of an ETs. The second thrust is to design and implement an electronic data base to manage storage and retrieval of the guidelines. This paper discusses the human factors issues that are unique to the design of a user interface for an ETS.

#### A87-33557# ASTROS - A MULTIDISCIPLINARY AUTOMATED STRUCTURAL DESIGN TOOL

D. J. NEILL, E. H. JOHNSON (Northrop Corp., Aircraft Div., Hawthorne, CA), and R. CANFIELD (USAF, Wright Aeronautical Laboratories, Wright-Patterson, AFB, OH) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987, Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1987, p. 44-53. refs (Contract F33615-83-C-3232)

(AIAA PAPER 87-0713)

ASTROS (Automated Structural Optimization System) is a multidisciplinary software system that can be used in the preliminary design of aerospace structures. The approach being taken in this ongoing development project is to blend proven engineering tools into an efficient unified system through the use of a specifically designed software environment. ASTROS has reached a stage of development at which significant test cases have been performed which demonstrate the power and versatility of the system. This paper first presents background information that motivates the development of this new system, followed by a discussion of the engineering technologies that have been integrated into ASTROS. Emphasis is placed on some of the more novel features, such as the treatment of flutter constraints and the linking of physical design variables. Insight into how the software environment has been applied to implement the multidisciplinary design features is then followed by two representative test cases.

#### A87-33560\*# Old Dominion Univ., Norfolk, Va. PRACTICAL IMPLEMENTATION OF AN ACCURATE METHOD FOR MULTILEVEL DESIGN SENSITIVITY ANALYSIS

DUC T. NGUYEN (Old Dominion University, Norfolk, VA) Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987, Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1987, p. 76-87. NASA-supported research. refs (AIAA PAPER 87-0718)

Solution techniques for handling large scale engineering optimization problems are reviewed. Potentials for practical applications as well as their limited capabilities are discussed. A new solution algorithm for design sensitivity is proposed. The algorithm is based upon the multilevel substructuring concept to be coupled with the adjoint method of sensitivity analysis. There are no approximations involved in the present algorithm except the usual approximations introduced due to the discretization of the finite element model. Results from the six- and thirty-bar planar truss problems show that the proposed multilevel scheme for sensitivity analysis is more effective (in terms of computer incore memory and the total CPU time) than a conventional (one level) scheme even on small problems. The new algorithm is expected to perform better for larger problems and its applications on the new generation of computer hardwares with 'parallel processing' capability is very promising.

### A87-33561\*# Auburn Univ., Ala. ANALYTICAL SOLUTIONS FOR STATIC ELASTIC DEFORMATIONS OF WIRE ROPES

K. KUMAR and J. E. COCHRAN, JR. (Auburn University, AL) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987, Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1987, p. 88-92. refs

(Contract NAG8-532) (AIAA PAPER 87-0720)

This paper develops closed-form solutions for extension of twisted wire ropes subjected to axial forces for two different end conditions. The analytical results are compared with the corresponding numerical results obtained by Costello and Phillips. A close agreement between the two establishes validity of the analytical solutions. Finally, an expression for the effective rigidity modulus of the wire ropes is obtained in terms of the helix angle and the number of helical wires in the rope for each of the two **Author** end conditions.

#### A87-33665\*# State Univ. of New York, Buffalo. VIBRATION SUPPRESSION USING A CONSTRAINED RATE-FEEDBACK THRESHOLD CONTROL STRATEGY

D. C. ZIMMERMAN, D. J. INMAN (New York, State University, Buffalo), and J.-N. JUANG (NASA, Langley Research Center, Hampton, VA) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2A . New York, American Institute of Aeronautics and Astronautics, 1987, p. 125-134. NASA-supported research.

(Contract NGT-33-183-801; NSF MEA-83-51807; ÀF-AFOSR-85-0220)

(AIAA PAPER 87-0741)

Quasi-closed form solutions are derived for the finite time, minimum force rate-feedback threshold controller to bring a system with or without known external disturbances back into an 'allowable' state manifold in finite time. The disturbances are assumed to be expandable in terms of Fourier series. The quasi-closed form solutions replace the solution of the two-point boundary value problem and definite integral constraints with the solution of algebraic equations and the calculation of matrix exponentials.

#### 02 MODELS, ANALYTICAL DESIGN TECHNIQUES, AND ENVIRONMENTAL DATA

Examples demonstrate the threshold control technique and compare the quasi-closed form solutions with MACSYMA generated exact solutions (for small system order) and with the numerical solution of the two-point boundary value problem. Author

#### A87-33728\*# Colorado Univ., Boulder. **EVALUATION OF CONSTRAINT STABILIZATION** PROCEDURES FOR MULTIBODY DYNAMICAL SYSTEMS

K. C. PARK and J. C. CHIOU (Colorado, University, Boulder) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2B . New York, American Institute of Aeronautics and Astronautics, 1987, p. 769-773, refs (Contract NAS1-17660) (AIAA PAPER 87-0927)

Comparative numerical studies of four constraint treatment techniques for the simulation of general multibody dynamic systems are presented, and results are presented for the example of a classical crank mechanism and for a simplified version of the seven-link manipulator deployment problem. The staggered stabilization technique (Park, 1986) is found to yield improved accuracy and robustness over Baumgarte's (1972) technique, the singular decomposition technique (Walton and Steeves, 1969), and the penalty technique (Lotstedt, 1979). Furthermore, the staggered stabilization technique offers software modularity, and the only data each solution module needs to exchange with the other is a set of vectors plus a common module to generate the gradient matrix of the constraints, B.

#### A87-35718\* Arizona State Univ., Tempe. A HYBRID NONLINEAR PROGRAMMING METHOD FOR **DESIGN OPTIMIZATION**

S. D. RAJAN (Arizona State University, Tempe) Journal of Structural Mechanics (ISSN 0360-1218), vol. 14, no. 4, 1986, p. 455-474. refs

(Contract NAG3-580)

Solutions to engineering design problems formulated as nonlinear programming (NLP) problems usually require the use of more than one optimization technique. Moreover, the interaction between the user (analysis/synthesis) program and the NLP system can lead to interface, scaling, or convergence problems. An NLP solution system is presented that seeks to solve these problems by providing a programming system to ease the user-system interface. A simple set of rules is used to select an optimization technique or to switch from one technique to another in an attempt to detect, diagnose, and solve some potential problems. Numerical examples involving finite element based optimal design of space trusses and rotor bearing systems are used to illustrate the applicability of the proposed methodology.

Author

#### A87-37135

#### STABILITY OF TIME VARYING LINEAR SYSTEMS

SHASHI K. SHRIVASTAVA and S. PRADEEP (Indian Institute of Science, Bangalore, India) IN: Space dynamics and celestial mechanics; Proceedings of the International Workshop, Delhi, India, Nov. 14-16, 1985 . Dordrecht, D. Reidel Publishing Co., 1986, p.

The history and fundamental principles of stability theory are examined in an analytical review, and some recent results are presented. Topics addressed include the early history of stability theory, stability of linear and nonlinear constant-parameter systems, periodic systems, second-order equations, arbitrarily time-varying systems, the absolute stability problem, and the functional analytical approach. The authors' recent work on multidimensional linear time-varying systems such as large space structures is summarized. and the results for the damped Mathieu equation (Pradeep and Shrivastava, 1986) are shown to be superior (for some parameter ranges) to those obtained by Taylor and Narenda (1969) and Gunderson et al. (1974).

A87-37298\* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. **REAL-TIME SIMULATION FOR SPACE STATION** 

ROBERT H. ST. JOHN (NASA, Johnson Space Center, Houston, TX), GERARD J. MOORMAN, and BLAINE W. BROWN (Lockheed Engineering and Management Services Co., Inc., Houston, TX) IEEE, Proceedings (ISSN 0018-9219), vol. 75, March 1987, p. 383-398. refs

Development of a new Space Station simulation designed to provide long-term support to the Space Station Program is well under way. A description of the two Engineering Directorate simulation facilities, the Systems Engineering Simulator and the Shuttle Avionics Integration Laboratory, is presented. The function of each in support of the Space Shuttle Program is discussed, with emphasis on functions applicable to Space Station. The function of the Systems Engineering Simulator in Space Station development is described. Finally, a comprehensive and detailed description of the new Space Station simulation under development on the System Engineering Simulator is presented.

#### A87-41611\*# Hughes Aircraft Co., Los Angeles, Calif. MODELING OF ENVIRONMENTALLY INDUCED TRANSIENTS WITHIN SATELLITES

N. JOHN STEVENS, GORDON J. BARBAY, MICHAEL R. JONES, and R. VISWANATHAN (Hughes Aircraft Co., Los Angeles, CA) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 24, May-June 1987, p. 257-263. refs (Contract NAS3-23869)

(AIAA PAPER 85-0387)

A technique is described that allows an estimation of possible spacecraft charging hazards. This technique, called SCREENS (spacecraft response to environments of space), utilizes the NASA charging analyzer program (NASCAP) to estimate the electrical stress locations and the charge stored in the dielectric coatings due to spacecraft encounter with a geomagnetic substorm environment. This information can then be used to determine the response of the spacecraft electrical system to a surface discharge by means of lumped element models. The coupling into the electronics is assumed to be due to magnetic linkage from the transient currents flowing as a result of the discharge transient. The behavior of a spinning spacecraft encountering a severe substorm is predicted using this technique. It is found that systems are potentially vulnerable to upset if transient signals enter through the ground lines.

#### A87-48602#

#### MISSION SCHEDULING EXPERT SYSTEM AND ITS SPACE STATION APPLICATIONS

T. YOSHIOKA (National Space Development Agency of Japan, Tokyo), T. KATO, T. WAKAKI, M. HORIO (Fujitsu, Ltd., Tokyo, Japan), N. SAKAMOTO (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) et al. AIAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 10 p. (AIAA PAPER 87-2221)

Japan has joined the United States Space Station program with its unique Japanese Experiment Module development scheme. This paper describes the mission scheduling expert system designed to prepare plans of these experiments (missions), and explains its operation. A prototype of the mission scheduling expert system has recently been developed. Evaluation of the prototype has demonstrated that the system should be able to prepare an objective mission operation plan (especially a medium-short term plan or a short term plan). The scheduling conditions for this prototype, as well as its functions, scheduling algorithms and heuristic knowledge, performance evaluation results, and subjects for further study are also described in detail.

A87-50412\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

#### ON THE INADEQUACIES OF CURRENT MULTI-FLEXIBLE **BODY SIMULATION CODES**

FIDELIS O. EKE and ROBERT A. LASKIN (California Institute of

Technology, Jet Propulsion Laboratory, Pasadena) IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 1. New York, American Institute of Aeronautics and Astronautics, 1987, p. 79-89. refs (AIAA PAPER 87-2248)

DISCOS was used to simulate the spin-up of a uniform flexible beam mounted on a rigid spinning disk. The system operated well for the first few seconds but then there was a drastic rise in deflection as the whole system became unstable. Attention is given to the reason for the breakdown of DISCOS and how this affects the simulation results from DISCOS and other multiflexible-body simulation programs. It is found that a formulation option already available in DISCOS will eliminate the dramatic divergence observed in high spin regimes and give good results in low spin regimes while requiring highly simplified input data. K.K.

N87-20373# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany). Abteilung Maschinenbau und Fahrzeuge.

MULTI-AXIS VIBRATION TESTS ON SPACECRAFT USING HYDRAULIC EXCITERS

H. HAHN and W. RAASCH In AGARD Mechanical Qualification of Large Flexible Spacecraft Structures 23 p Jul. 1986
Avail: NTIS HC A12/MF A01

Based on performance data that are specified for a spacecraft multi-axis hydraulic vibration test facility by ESA the feasibility of such a test facility is investigated. Technical problems and possible solutions concerning test table stiffness, elasticity of actuator oil column, actuator joints and oil consumption are discussed. More sophisticated problems may arise concerning the control and safety systems. The designed solutions include controllers for each individual actuator, controllers for a coordinated control of the multiple actuator system and a safety and monitoring system. The control system has to be based on a control strategy using a combination of analog fixed algorithm controllers and a digital variable algorithm controller both together performing individual degree of freedom control including suitable decoupling procedures. The safety system has to be based on a triple redundancy concept for critical system components. It is recommended to built it by a digital multi-processor system. The investigations lead to the statement that multi-axis vibration tests of spacecrafts are realizable with respect to the necessary test equipment.

N87-20581\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

#### MODAL TEST AND ANALYSIS: MULTIPLE TESTS CONCEPT FOR IMPROVED VALIDATION OF LARGE SPACE STRUCTURE MATHEMATICAL MODELS

B. K. WADA, C-P. KUO, and R. J. GLASER In Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 2: Modal Test and Analysis, Testing Techniques, Machinery Dynamics, Isolation and Damping, Structural Dynamics p 1-8 Aug. 1986

Avail: NTIS HC A10/MF A01 CSCL 22B

For the structural dynamic analysis of large space structures, the technology in structural synthesis and the development of structural analysis software have increased the capability to predict the dynamic characteristics of the structural system. The various subsystems which comprise the system are represented by various displacement functions; the displacement functions are then combined to represent the total structure. Experience has indicated that even when subsystem mathematical models are verified by test, the mathematical representations of the total system are often in error because the mathematical model of the structural elements which are significant when loads are applied at the interconnection points are not adequately verified by test. A multiple test concept, based upon the Multiple Boundary Condition Test (MBCT), is presented which will increase the accuracy of the system mathematical model by improving the subsystem test and Author test/analysis correlation procedure.

N87-21020\*# Engineering, Inc., Hampton, Va.
THE RESULTS OF A LIMITED STUDY OF APPROACHES TO
THE DESIGN, FABRICATION, AND TESTING OF A DYNAMIC
MODEL OF THE NASA IOC SPACE STATION. EXECUTIVE
SUMMARY

GEORGE W. BROOKS Aug. 1985 150 p (Contract NAS1-16610)

(NASA-CR-178276; NAS 1.26:178276; EI-278-R518) Avail: NTIS HC A07/MF A01 CSCL 22B

The options for the design, construction, and testing of a dynamic model of the space station were evaluated. Since the definition of the space station structure is still evolving, the Initial Operating Capacity (IOC) reference configuration was used as the general guideline. The results of the studies treat: general considerations of the need for and use of a dynamic model; factors which deal with the model design and construction; and a proposed system for supporting the dynamic model in the planned Large Spacecraft Laboratory.

# N87-21154\*# Battelle Pacific Northwest Labs., Richland, Wash. TWO-PHASE REDUCED GRAVITY EXPERIMENTS FOR A SPACE REACTOR DESIGN

ZENEN I. ANTONIAK In NASA. Lewis Research Center Microgravity Fluid Management Symposium p 163-169 Apr. 1987

Avail: NTIS HC A10/MF A01 CSCL 22A

Future space missions researchers envision using large nuclear reactors with either a single or a two-phase alkali-metal working fluid. The design and analysis of such reactors require state-of-the-art computer codes that can properly treat alkali-metal flow and heat transfer in a reduced-gravity environment. New flow regime maps, models, and correlations are required if the codes are to be successfully applied to reduced-gravity flow and heat transfer. General plans are put forth for the reduced-gravity experiments which will have to be performed, at NASA facilities, with benign fluids. Data from the reduced-gravity experiments with innocuous fluids are to be combined with normal gravity data from two-phase alkali-metal experiments. Because these reduced-gravity experiments will be very basic, and will employ small test loops of simple geometry, a large measure of commonality exists between them and experiments planned by other organizations. It is recommended that a committee be formed to coordinate all ongoing and planned reduced gravity flow experiments.

N87-21661\* National Aeronautics and Space Administration. Pasadena Office, Calif.

VARIABLE ENERGY, HIGH FLUX, GROUND-STATE ATOMIC OXYGEN SOURCE Patent

ARA CHUTJIAN, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena) and OTTO J. ORIENT, inventor (to NASA) 10 Mar. 1987 12 p Filed 10 Apr. 1986 Supersedes N86-27055 (24 - 17, p 2809)

(NASA-CASE-NPO-16640-1-CU; US-PATENT-4,649,273; US-PATENT-APPL-SN-852468; US-PATENT-CLASS-250-251; US-PATENT-CLASS-250-396-R; US-PATENT-CLASS-250-423-P; US-PATENT-CLASS-376-127) Avail: US Patent and Trademark Office CSCL 20H

A variable energy, high flux atomic oxygen source is described which is comprised of a means for producing a high density beam of molecules which will emit O(-) ions when bombarded with electrons; a means of producing a high current stream of electrons at a low energy level passing through the high density beam of molecules to produce a combined stream of electrons and O(-) ions; means for accelerating the combined stream to a desired energy level; means for producing an intense magnetic field to confine the electrons and O(-) ions; means for directing a multiple pass laser beam through the combined stream to strip off the excess electrons from a plurality of the O(-) ions to produce ground-state O atoms within the combined stream; electrostatic deflection means for deflecting the path of the O(-) ions and the electrons in the combined stream; and, means for stopping the O(-) ions and the electrons and for allowing only the ground-state O atoms to continue as the source of the atoms of interest. The

#### 02 MODELS, ANALYTICAL DESIGN TECHNIQUES, AND ENVIRONMENTAL DATA

method and apparatus are also adaptable for producing other ground-state atoms and/or molecules.

Official Gazette of the U.S. Patent and Trademark Office

N87-21995\*# General Electric Co., Philadelphia, Pa. Astro-Space Div.

## THE MULTI-DISCIPLINARY DESIGN STUDY. A LIFE CYCLE COST ALGORITHM

R. R. HARDING, J. M. DURAN, and R. R. KAUFFMAN May 1987 107 p

(Contract NAS1-18032)

material.

(NASA-CR-178192; NAS 1.26:178192; GE-DOC-87SDS-024) Avail: NTIS HC A06/MF A01 CSCL 22B

Life-cycle cost (LCC) is investigated as a comprehensive design criterion for two major interrelated spacecraft subsystems, Controls and Structures. A Multi-Disciplinary Design Tool (MDDT) is developed to evaluate the sensitivity of LCC to subsystem design parameters. Major costs addressed are: non-recurring; launch; ground support; maintenance; expendables; and software. Examples and results from the MDDT are described, including a structural optimization study between different truss designs; a solar array feathering trade for a minimal drag configuration during umbra; and the cost of active control of a flexible structure is compared against the cost of passive damping using visco-elastic

N87-22711\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

# CONSIDERATIONS IN THE DESIGN AND DEVELOPMENT OF A SPACE STATION SCALE MODEL

PAUL E. MCGOWAN *In* NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 215-246 Apr. 1987

Avail: NTIS HC A99/MF E03 CSCL 22B

Preliminary work at Langley Research Center (LaRC) related to the design, analysis and testing of a space station scale model is reviewed. Included are some rationale for focusing the scale model program on space station and the utilization of the model to achieve the program objectives. In addition, some considerations involved in designing a dynamics scale model, such as ground test facilities, sub-scale component fabrication and model replication vs. simulation are presented. Finally, some related research areas currently ongoing at LaRC in support of scale model development are discussed.

N87-22716\*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

COMMIT YOUR WORKS TO THE LORD, AND YOUR THOUGHTS SHALL BE ESTABLISHED (PROV. 16:3). INTER-STABLE CONTROL SYSTEMS

GEORGE L. VONPRAGENAU In its Structural Dynamics and Control Interaction of Flexible Structures p 335-358 Apr. 1987 Avail: NTIS HC A99/MF E03 CSCL 22B

Algebraic structures are discussed for control systems that maintain stability in the presence of resonance uncertainties. Dual algebraic operations serve as elementary connections that propagate the stability of inter-stable subsystems. Frequency responses within complex half-planes define different types of inter-stability. Dominance between incompatible types is discussed. Inter-stability produces sufficient but unnecessary stability conditions, except for conservative systems where the conditions become also necessary. Multivariable systems, colocation of passivity, inter-stability relates stability to the mapping of poles and zeros by transfer functions and transfer matrices. Inter-stability determines stability on the subsystem level, is less complex even for multivariable systems, adds design flexibility, and relaxes the dynamic data problem of large systems such as space stations.

**Author** 

Author

N87-22721\*# Rockwell International Corp., Downey, Calif. Space Station Systems Div.

# STRUCTÚRAL/CONTROL INTERACTION (PAYLOAD POINTING AND MICRO-G)

C. R. LARSON *In* NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 457-484 Apr. 1987

Avail: NTIS HC A99/MF E03 CSCL 22B

A 203rd order simulation model was developed to evaluate the space station customer accommodation payload pointing and micro-g requirements. The simulation shows the pointing errors on the telescope are significantly smaller than at the base of the telescope. The pointing results could change when the parametric studies are performed. The results show the micro-g requirement is met with an active isolation system.

N87-22735\*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

## A TREETOPS SIMULATION OF THE HUBBLE SPACE TELESCOPE-HIGH GAIN ANTENNA INTERACTION

JOHN P. SHARKEY *In its* Structural Dynamics and Control Interaction of Flexible Structures p 881-902 Apr. 1987 Avail: NTIS HC A99/MF E03 CSCL 20K

Virtually any project dealing with the control of a Large Space Structure (LSS) will involve some level of verification by digital computer simulation. While the Hubble Space Telescope might not normally be included in a discussion of LSS, it is presented to highlight a recently developed simulation and analysis program named TREETOPS. TREETOPS provides digital simulation, linearization, and control system interaction of flexible, multibody spacecraft which admit to a point-connected tree topology. The HST application of TREETOPS is intended to familiarize the LSS community with TREETOPS by presenting a user perspective of its key features.

N87-22741\*# Harris Corp., Melbourne, Fla. Government Aerospace Systems Div.

# MAXIMUM ENTROPY/OPTIMAL PROJECTION (MEOP) CONTROL DESIGN SYNTHESIS: OPTIMAL QUANTIFICATION OF THE MAJOR DESIGN TRADEOFFS

D. C. HYLAND and D. S. BERNSTEIN /n NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 1033-1070 Apr. 1987 Avail: NTIS HC A99/MF E03 CSCL 22B

The underlying philosophy and motivation of the optimal projection/maximum entropy (OP/ME) stochastic modeling and reduced control design methodology for high order systems with parameter uncertainties are discussed. The OP/ME design equations for reduced-order dynamic compensation including the effect of parameter uncertainties are reviewed. The application of the methodology to several Large Space Structures (LSS) problems of representative complexity is illustrated.

N87-23157\*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

## TAE PLUS: A CONCEPTUAL VIEW OF TAE IN THE SPACE STATION ERA

MARTHA SZCZUR In its Sixth Annual Users' Conference p
19-30 Oct. 1986

Avail: NTIS HC A11/MF A01 CSCL 09B

The use of the Transportable Applications Executive (TAE) for prototyping user interfaces has been the prime force behind the new TAE research and development work. The Data Systems Technology Division at GSFC is developing prototypes of user interfaces for different functions involved in the operation, analysis and data communication of space station payloads. TAE is a valuable prototyping tool because it enables a developer to build an entire application user interface model and run it without writing a single line of application code. One force driving new development is the need to update TAE's user interface to support the latest interactive graphic device technology. The current TAE, TAE Classic, uses interface techniques designed for an 80x24 character monochrome alphanumeric terminal, but does not effectively utilize

#### 02 MODELS, ANALYTICAL DESIGN TECHNIQUES, AND ENVIRONMENTAL DATA

features such as windowing, graphics, color, and selection devices available on newer workstations. To meet our needs, development of a TAE Plus began in FY-86 and involves augmenting TAE with three different sets of tools: a user interface toolkit; an application toolkit; and run-time service subroutines. A phased approach is being used to develop TAE Plus. In the first phase, we have met the needs of the user community and provided some support for rapid prototyping by developing a TAE Facelift, which adds an enhanced TAE interface (with windowing, mouse interaction, pull-down menus, etc.) to a select set of graphic workstations. The TAE Facelift allows many new concepts to be tested quickly for feedback and performance. In the second phase, a fully-integrated user interface management system, TAE Plus, will be built that supports the separation of interface from application, with the concomitant ability to prototype and rapidly change interfaces. This robust functionality will support, in an integrated manner, an application's development cycle from the prototype step through to the fully operational system.

N87-24709\*# Edighoffer, Inc., Newport News, Va.
DYNAMIC AND THERMAL RESPONSE FINITE ELEMENT
MODELS OF MULTI-BODY SPACE STRUCTURAL
CONFIGURATIONS Final Report

HAROLD H. EDIGHOFFER Apr. 1987 156 p (Contract NAS1-17210)

(NASA-CR-178289; NÁS 1.26:178289) Avail: NTIS HC A08/MF A01 CSCL 20K

Presented is structural dynamics modeling of two multibody space structural configurations. The first configuration is a generic space station model of a cylindrical habitation module, two solar array panels, radiator panel, and central connecting tube. The second is a 15-m hoop-column antenna. Discussed is the special joint elimination sequence used for these large finite element models, so that eigenvalues could be extracted. The generic space station model aided test configuration design and analysis/test data correlation. The model consisted of six finite element models, one of each substructure and one of all substructures as a system. Static analysis and tests at the substructure level fine-tuned the finite element models. The 15-m hoop-column antenna is a truss column and structural ring interconnected with tension stabilizing cables. To the cables, pretensioned mesh membrane elements were attached to form four parabolic shaped antennae, one per quadrant. Imposing thermal preloads in the cables and mesh elements produced pretension in the finite element model. Thermal preload variation in the 96 control cables was adjusted to maintain antenna shape within the required tolerance and to give pointing Author accuracy.

N87-26205\*# Lockheed Missiles and Space Co., Palo Alto, Calif.

## SPACECRAFT RAM GLOW AND SURFACE TEMPERATURE Abstract Only

G. R. SWENSON, S. B. MENDE, and E. J. LLEWELLYN (Saskatchewan Univ., Saskatoon.) In Jet Propulsion Lab., Proceedings of the NASA Workshop on Atomic Oxygen Effects p 169 1 Jun. 1987

Avail: NTIS HC A09/MF A01 CSCL 22B

Space shuttle glow intensity measurements show large differences when the data from different missions are compared. In particular, on the 41-G mission the space shuttle ram glow was observed to display an unusually low intensity. Subsequent investigation of this measurement and earlier measurements suggest that there was a significant difference in temperature of the glow producing ram surfaces. The highly insulating properties coupled with the high emissivity of the shuttle tile results in surfaces that cool quickly when exposed to deep space on the night side of the orbit. The increased glow intensity is consistent with the hypothesis that the glow is emitted from excited NO2. The excited NO2 is likely formed through three body recombination (OI + NO + M = NO2\*) where ramming of OI interacts with weakly surface bound NO. The NO is formed from atmospheric OI and NI which is scavenged by the spacecraft moving through the atmosphere. It is postulated that the colder surfaces retain a thicker layer of

NO thereby increasing the probability of the reaction. It has been found from the glow intensity/temperature data that the bond energy of the surface bound precursor, leading to the chemical recombination producing the glow, is approximately 0.14 eV. A thermal analysis of material samples of STS-8 was made and the postulated temperature change of individual material samples prior to the time of glow measurements above respective samples are consistent with the thermal effect on glow found for the orbiter surface.

N87-27412\*# Illinois Univ., Urbana. Dept. of Computer Science.

SAGA: A PROJECT TO AUTOMATE THE MANAGEMENT OF SOFTWARE PRODUCTION SYSTEMS Mid-Year Report, 1986 ROY H. CAMPBELL, C. S. BECKMAN-DAVIES, L. BENZINGER, G. BESHERS, D. LALIBERTE, H. RENDER, R. SUM, W. SMITH, and R. TERWILLIGER 21 Oct. 1986 607 p (Contract NAG1-138)

(NASA-CR-180276; NAS 1.26:180276) Avail: NTIS HC A99/MF A01 CSCL 09B

Research into software development is required to reduce its production cost and to improve its quality. Modern software systems, such as the embedded software required for NASA's space station initiative, stretch current software engineering techniques. The requirements to build large, reliable, and maintainable software systems increases with time. Much theoretical and practical research is in progress to improve software engineering techniques. One such technique is to build a software system or environment which directly supports the software engineering process, i.e., the SAGA project, comprising the research necessary to design and build a software development which automates the software engineering process. Progress under SAGA is described.

N87-29002# Societe Nationale Industrielle Aerospatiale, Cannes (France). Div. Systemes Balistiques et Spatiaux.

#### COMPUTER SIMULATION OF DEPLOYMENT

CH. ROUX and P. FLAMENT In ESA Proceedings of the Fifth European Symposium on Photovoltaic Generators in Space p 305-311 Nov. 1986

Avail: NTIS HC A21/MF A01

A solar array deployment analysis software, ADAMS, was developed. The ADAMS program improves predictability of dynamic phenomena during deployment; understanding of influences from component flexibilities during deployment; and inflight predictions (geometry, spacecraft motions). These enhance accuracy in optimizing mechanisms as to mechanical strength under deployment loads and latching shocks, motorization factors, and layout on solar array; and predicting all in-orbit deployment (including, possibly, failure) cases to make sure of no unexpected disturbances of spaceflight. Ground tests of deployment geometry can be eliminated.

N87-29129\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

## ENGINEERING GRAPHICS AND IMAGE PROCESSING AT LANGLEY RESEARCH CENTER

SUSAN J. VOIGT In NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, Volume 1 5 p Aug. 1985

Avail: NTIS HC A16/MF A01 CSCL 09B

The objective of making raster graphics and image processing techniques readily available for the analysis and display of engineering and scientific data is stated. The approach is to develop and acquire tools and skills which are applied to support research activities in such disciplines as aeronautics and structures. A listing of grants and key personnel are given.

R.J.F.

N87-29893# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Mathematics.

MODELING AND COMPUTATIONAL ALGORITHMS FOR PARAMETER ESTIMATION AND OPTIMAL CONTROL OF AEROELASTIC SYSTEMS AND LARGE FLEXIBLE STRUCTURES Final Report, 30 Sep. 1985 - 30 Sep. 1986 J. A. BURNS and E. M. CLIFF 1 Nov. 1986 5 p. (Contract AF-AFOSR-0287-85)

(AD-A183302; AFOSR-87-0956TR) Avail: NTIS HC A02/MF A01

The goal of this research is to develop computational algorithms for identifications and control, especially with application to aeroelastic and viscoelastic systems. The research has emphasized development of Chandresekhar algorithms for optimal control of distributed systems and state models and computational algorithms for aeroelastic control systems. During this period, the investigators developed fast algorithms for the general linear quadratic optimal control problems for functional differential equations using Chandresekhar factorization techniques. The resulting algorithms show improved rates of convergence over Ricatti techniques and for certain large problems is the only algorithms which was shown to converge in practice. Nine publications were produced during this period under this grant, including Factorization and Reduction Methods for Optimal Control of Hereditary Systems and Modeling and Approximation for a Viscoelastic Control Problem.

N87-30107\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

A SPLINE-BASED PARAMETER AND STATE ESTIMATION TECHNIQUE FOR STATIC MODELS OF ELASTIC SURFACES H. T. BANKS, P. L. DANIEL (Southern Methodist Univ., Dallas, Tex.), and E. S. ARMSTRONG 28 Jun. 1983 62 p

(Contract NAS1-15810; NAS1-16394; NAG1-258; NSF MCS-82-05355; AF-AFOSR-0198-81; NSF MCS-82-00883)

(NASA-CR-180449; ICASE-83-25; NAS 1.26:180449) Avail: NTIS HC A04/MF A01 CSCL 12A

Parameter and state estimation techniques for an elliptic system arising in a developmental model for the antenna surface in the Maypole Hoop/Column antenna are discussed. A computational algorithm based on spline approximations for the state and elastic parameters is given and numerical results obtained using this algorithm are summarized.

03

#### STRUCTURAL CONCEPTS

Includes analyses and descriptions of different Space Station structural concepts, arrangements, testing, methods of construction and/or manufacturing and specific rotary joints, structural nodes, and columns.

#### A87-31505

#### FIBER-OPTIC MONITORS FOR SPACE STRUCTURES

W. S. OTAGURO, R. J. MICHAL, and S. F. WATANABE (McDonnell Douglas Astronautics Co., Huntington Beach, CA) IN: Digital Avionics Systems Conference, 7th, Fort Worth, TX, Oct. 13-16, 1986, Proceedings . New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 433-436. refs

The application of fiber-optic interferometric sensors for space use is becoming very attractive due to significant progress made in recent years in the development of producible fiber-optic modules. Both Mach-Zehnder or Sagnac configurations can be used to provide either length and area structural monitors. Fiber-optic length monitors can measure strains (elongations and compressions) from 0.1 micrometers to 1.0 millimeters from dc to 2000 Hz with a temperature compensation. Fiber-optic acoustic area monitors can locate and quantify structural damage caused by micrometeorite impacts or surface defects. By incorporating the fiber-optic sensor technology from related efforts, the

development of these fiber-optic structural monitors is reduced to transducer design and packaging. A description of the Mach-Zehnder and Sagnac fiber interferometers configured to monitor strain is provided. Data from a breadboard Sagnac strain sensor is presented.

A87-32058\* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

#### A SPACE DEBRIS SIMULATION FACILITY FOR SPACECRAFT **MATERIALS EVALUATION**

ROY A. TAYLOR (NASA, Marshall Space Flight Center, Huntsville, SAMPE Quarterly (ISSN 0036-0821), vol. 18, Jan. 1987, p. 28-34. refs

A facility to simulate the effects of space debris striking an orbiting spacecraft is described. This facility was purchased in 1965 to be used as a micrometeoroid simulation facility. Conversion to a Space Debris Simulation Facility began in July 1984 and it was placed in operation in February 1985. The facility consists of a light gas gun with a 12.7-mm launch tube capable of launching 2.5-12.7 mm projectiles with a mass of 4-300 mg and velocities of 2-8 km/sec, and three target tanks of 0.067 m, 0.53 a m and 28.5 a m. Projectile velocity measurements are accomplished via pulsed X-ray, laser diode detectors, and a Hall photographic station. This facility is being used to test development structural configurations and candidate materials for long duration orbital spacecraft. A summary of test results are also described. Author

#### A87-32120

#### SPACE STRUCTURE VIBRATION MODES - HOW MANY **EXIST? WHICH ONES ARE IMPORTANT?**

PETER C. HUGHES (Toronto, University, Downsview, Canada) IEEE Control Systems Magazine (ISSN 0272-1708), vol. 7, Feb. 1987, p. 22-28. refs (Contract NSERC-A-4183)

Basic concepts of vibration modes analysis are re-evaluated to demonstrate techniques for discerning between significant physical vibration modes and mathematical models of modes. Generic integral equations are defined for the modal coefficients of momentum and angular momentum. When applied to a complex structure, the equations are solved by convergence of finite element calculations, i.e., an approximation is made. The calculations are a numerical equivalent of exact solutions to partial differential equations, but do not extend to 'absurd' orders of modes. Low frequency modes are identified as the important modes. Error indices are discussed for truncating the number of modes that must be considered, noting that frequency is not the only parameter of importance in modal selection. M.S.K.

### A87-32229#

ROBUST CONTROLLER DESIGN USING FREQUENCY **DOMAIN CONSTRAINTS** 

R. D. HEFNER (Aerospace Corp., El Segundo, CA) and D. L. MINGORI (California, University, Los Angeles) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 10.

Mar.-Apr. 1987, p. 158-165. refs
This paper describes a method for designing a controller with improved robustness with respect to truncated flexible modes. The approach involves minimization of a quadratic performance index subject to constraints in the frequency domain. The frequency domain criteria are chosen so as to sufficiently attenuate the high frequency response of the full dynamic system while attempting to maintain the overall performance of the closed-loop system. The resulting constraint relationships are cast into a functional minimization framework and parameter optimization techniques are used to determine the solution.

A87-32336\* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

### VALIDATION OF LARGE SPACE STRUCTURES BY GROUND

B. K. WADA, C. P. KUO, and R. J. GLASER (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) International Symposium on Space Technology and Science, 15th,

Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 1 . Tokyo, AGNE Publishing, Inc., 1986, p. 465-474. refs (Contract NAS7-918)

The paper presents concepts designed to validate, through the use of ground tests, mathematical models of continuous type structures and structures comprised of interconnecting subsystems. For continuous-type structures, a multiple boundary condition test approach is considered in which the basic idea is to perform a large number of tests using artificial boundary conditions from which good ground test data can be obtained. The test ensures an arbitrarily large number of test data for use in the validation and updating of the mathematical model. Another approach, applicable to structures comprised of subsystems, involves the identification of significant structural elements for the system dynamic model which are not validated by standard modal tests of the subsystems.

A87-32337\* Howard Univ., Washington, D. C. A REVIEW OF MODELLING TECHNIQUES FOR THE OPEN AND CLOSED-LOOP DYNAMICS OF LARGE SPACE SYSTEMS PETER M. BAINUM (Howard University, Washington, DC) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 1. Tokyo, AGNE Publishing, Inc., 1986, p. 475-482. Research supported by Howard University and Nippon Telegraph and Telephone Public Corp. refs (Contract NSG-1414)

This paper reviews the steps in the development of mathematical models that can be used to simulate the in-orbit dynamic behavior of large flexible systems. A general continuum formulation is compared with the hybrid coordinate formulation and also a finite element representation of the total system. A review of structural analysis routines emphasizes the use of computer generated graphics to help understand the different modal elastic shape functions of complex systems. Numerical techniques employed to synthesize shape and attitude control laws are summarized. Finally, the modeling of environmental disturbance torques due to the interaction of solar radiation pressure on vibrating and thermally deflected systems is discussed.

#### A87-32340

## DESIGN CONSIDERATION OF MECHANICAL AND DEPLOYMENT PROPERTIES OF A COILABLE LATTICE MAST

K. OKAZAKI, S. SATO, A. OBATA (Japan Aircraft Manufacturing Co., Ltd., Yokohama, Japan), M. NATORI, and K. MIURA (Tokyo, University, Japan) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 1. Tokyo, AGNE Publishing, Inc., 1986, p. 497-502.

An analytical approach is presented to extract suitable values of elements for fundamental design of coilable lattice masts. The large deflection of each element in the transition zone makes the analysis difficult. In this paper, deploying mode analyses using strain energy calculations with some reasonable assumptions based on experimental results are presented.

Author

#### A87-32405

# THERMAL DEFORMATION AND ELECTRICAL DEGRADATION OF ANTENNA REFLECTOR WITH TRUSS BACKSTRUCTURE

KOHEI OHATA and TAKEHIKO KOBAYASHI (Nippon Telegraph and Telephone Public Corp., Yokosuka Electrical Communications Laboratory, Japan) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 1. Tokyo, AGNE Publishing, Inc., 1986, p. 955-960.

A large high-precision reflector required for 20/30 GHz multibeam on-board antennas is investigated. A reflector with a truss back-structure constructed of CFRP is expected to have good performance in suppression of excessive thermal deformations in space. The thermal deformation characteristics of this antenna are estimated both experimentally and analytically. The effects of the deformation on electrical performance are

analyzed, giving special attention to the multibeam applications. It is observed that the periodic deformation has a pronounced effect on sidelobe level.

#### A87-32442

## FLEXIBILITY CONTROL OF TORSIONAL VIBRATIONS OF A LARGE SOLAR ARRAY

TOSHIO FUKUDA, HIDEMI HOSOGAI (Tokyo University of Science, Japan), NOBUYUKI YAJIMA (Ministry of International Trade and Industry, Mechanical Engineering Laboratory, Tsukuba, Japan), and FUMIHITO ARAI IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 1243-1248. refs

This paper describes modeling and control methods for torsional vibration of flexible solar arrays. The eigenvalues and eigenfunctions for this distributed parameter system are solved both mathematically and numerically under the consideration of the inertia momentum of the supported rigid attachment. A differential solar cells sensor consisting of a pair of adjacent solar cells is proposed as a new type of sensor to measure the attitude and torsional vibrations of flexible solar arrays. To eliminate noises in the sensor outputs, the Kalman filtering method is employed. A proposed mode estimation method, based on this linear optimal filter, is show to give good results. The control method employing the optimal control theory, based on the quadratic performance index approach, is also shown to suppress the torsional vibration of the flexible array.

#### A87-32443

# TWO-TIME-SCALE DESIGN OF ROBUST CONTROLLERS FOR LARGE STRUCTURE SYSTEMS

M. SUZUKI (Nagoya University, Japan), T. NARUSE (Daido Institute of Technology, Nagoya, Japan), Y. ANDO (Nagoya Municipal Industrial Research Institute, Japan), and S. KURACHI IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 1249-1254.

The two time-scale design method of the singular perturbation system is decribed. The design method is used to determine the robust control design for large structure systems; the method is applied to the vibration control of a flexible beam. The advantages of the singular perturbation method for determining the robust stabilization control for large structure systems are discussed.

I.F.

#### A87-32545

## STUDY OF ACTUATOR FOR LARGE SPACE MANIPULATOR ARM

K. MACHIDA, T. IWATA, Y. TODA, M. KAWADA (Ministry of International Trade and Industry, Electrotechnical Laboratory, Sakura, Japan), Y. KURITA (Toshiba Corp., Kawasaki, Japan) et al. IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 2017-2022.

Results are reported from studies of basic technologies for a long-life RMS for the Space Station, mostly for use with the Japan Module. The new arm will provide 10 m reach and will need high torque and a lifetime of more than 10 yr. The research covered an actuator model developing 700 Nm torque at 0.05 rad/sec and 3.4 Nm at 17.6 rad/sec with a reduction ratio of 351 in the planetary gear box, a ratio which permits use of a solid lubricant. A cutaway view is provided of the actuator, which has a dc brushless motor with 3-phase windings and a rare-earth metal magnet. The gear testing equipment employed in 1111 hr tests to validate the actuator performance in vacuum is also described. Gear alloys and greases which exhibited satisfactory durability in the tests are identified.

#### A87-32548

### STRUCTURE AND FUNCTION OF DEPLOYABLE TRUSS BEAM

SEISHIRO KIBE, YOSHINORI FUJIMORI (National Aerospace

Laboratory, Tokyo, Japan), KUNIHIKO KAWAKAMI, TATSUYA HAMAGUCHI, MASAYUKI TOMITA (Mitsubishi Electric Corp., Amagasaki, Japan) et al. IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 2035-2040.

This paper describes the concept study of the deployable truss beam (DTB) and the development of its key parts (i.e., two types of latches). DTB will be applicable to the common facility of the Space Station and as a supportive bench for specific missions, for it can provide the adequate field of view, cut off contamination from/to the Space Station core and enlarge the working area. The Solar Energy Concentration System, the Large Antenna assembly, and Tether Boomerang systems are supposed to be prospective missions for DTB.

A87-32658\* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

STATIC SHAPE CONTROL FOR FLEXIBLE STRUCTURES

G. RODRIGUEZ and R. E. SCHEID, JR. (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 13-16, 1986. 16 p. NASA-supported research. (SAE PAPER 861822)

An integrated methodology is described for defining static shape control laws for large flexible structures. The techniques include modeling, identifying and estimating the control laws of distributed systems characterized in terms of infinite dimensional state and parameter spaces. The models are expressed as interconnected elliptic partial differential equations governing a range of static loads, with the capability of analyzing electromagnetic fields around antenna systems. A second-order analysis is carried out for statistical errors, and model parameters are determined by maximizing an appropriate defined likelihood functional which adjusts the model to observational data. The parameter estimates are derived from the conditional mean of the observational data, resulting in a least squares superposition of shape functions obtained from the structural model.

M.S.K.

#### A87-32729

# THE MAST FLIGHT SYSTEM DYNAMIC CHARACTERISTICS AND ACTUATOR/SENSOR SELECTION AND LOCATION

J. W. SHIPLEY and D. C. HYLAND (Harris Corp., Melbourne, FL) IN: Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986. San Diego, CA, Univelt, Inc., 1986, p. 31-49. (AAS PAPER 86-003)

The NASA Mast Flight System (MFS), which will serve as a test bed for the development of validation methodology for large space structures (LSS) and the accompanying control design methodology, described. MFS will consist is deployable/retractable truss beam 60 m or greater in length with a 100 kg tip mass, the latter being included to couple the first torsional mode with either the first or second bending mode. The system will include the capability of parameter alterations to change the modal frequency spacing and couple modes geometrically in a controlled manner. The design criteria for the MFS to ensure that the tests are valid for larger structures, cost-effective to perform, and harmonious with Orbiter operations are delineated. The designs, placement and operations of the linear dc motor actuators to achieve the mission goals are summarized.

#### A87-33551

#### STRUCTURES, STRUCTURAL DYNAMICS AND MATERIALS CONFERENCE, 28TH, MONTEREY, CA, APR. 6-8, 1987, TECHNICAL PAPERS. PART 1

Conference sponsored by AIAA, ASME, ASCE, and AHS. New York, American Institute of Aeronautics and Astronautics, 1987, 884 p. For individual items see A87-33552 to A87-33653.

The present conference considers the structural behavior of solid rocket motor field joints, design engineering technologies for aerospace vehicles, the generalization of an equivalent plate representation for aircraft structural analysis, control-augmented structural synthesis with transient response constraints, the optimal design of flexible arches, compressive deformation in polymer fibers, a probabilistic Hu-Washizu variational principle, the extension-twist coupling of composite circular tubes for tilt rotor blade applications, and a creep-rupture model of filament-wound spherical pressure vessels. Also discussed are tough advanced composite structures, simultaneous structure/control optimization of large flexible spacecraft, improved optimum design of dewar supports, the shear strength of structural adhesives, the performance of trigonometric-basis function finite elements in Timoshenko beams, on-orbit damage assessment for large space structures, and the structural tailoring of advanced turboprops.

O.C.

#### A87-33564#

## AN EQUIVALENT CONTINUUM ANALYSIS PROCEDURE FOR SPACE STATION LATTICE STRUCTURES

JOHN O. DOW and STEPHEN A. HUYER (Colorado, University, Boulder) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1987, p. 110-122. refs (AIAA PAPER 87-0724)

A procedure for determining the equivalent continuum properties of a structure composed of repeated patterns of discrete elements with both displacement and rotation coordinates is presented. These nodal coordinates are transformed to rigid body and strain gradient variables using a polynomial representation. The set of independent strain gradient variables is identified by inspection and depends on the geometry of the structure being modeled. The possibility of introducing errors by requiring the analyst to supply the strain gradient terms directly is eliminated. The procedure is applied to six example problems, including two in which the effect of structural damage on the stiffness characteristics of the structure is analyzed. The compactness of the procedure makes it particularly suited for the preliminary design stage and implementation on personal computers.

**A87-33565\***# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

## A LANCZOS EIGENVALUE METHOD ON A PARALLEL COMPUTER

SUSAN W. BOSTIC and ROBERT E. FULTON (NASA, Langley Research Center, Hampton, VA) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1987, p. 123-134. refs (AIAA PAPER 87-0725)

Eigenvalue analyses of complex structures is a computationally intensive task which can benefit significantly from new and impending parallel computers. This study reports on a parallel computer implementation of the Lanczos method for free vibration analysis. The approach used here subdivides the major Lanczos calculation tasks into subtasks and introduces parallelism down to subtask levels such as matrix decomposition and forward/backward substitution. The method was implemented on a commercial parallel computer and results were obtained for a long flexible space structure. While parallel computing efficiency is problem and computer dependent, the efficiency for the Lanczos method was good for a moderate number of processors for the test problem. The greatest reduction in time was realized for the decomposition of the stiffness matrix, a calculation which took 70 percent of the time in the sequential program and which took 25 percent of the time on eight processors. For a sample calculation of the twenty lowest frequencies of a 486 degree of freedom problem, the total sequential computing time was reduced by almost a factor of ten using 16 processors. Author

#### A87-33588#

## STRUCTURAL OPTIMIZATION WITH FREQUENCY CONSTRAINTS

R. V. GRANDHI (Wright State University, Dayton, OH) and V. B. VENKAYYA (USAF, Flight Dynamics Laboratory, Wright-Patterson

AFB, OH) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1987, p. 322-333. USAF-supported research. refs (AIAA PAPER 87-0787)

This paper presents a design optimization algorithm for structural weight minimization with multiple frequency constraints. An optimality criterion method based on uniform Lagrangian density for resizing and a scaling procedure to locate the constraint boundary were used in optimization. Multiple frequency constraints of equality and inequality types were addressed. The effectiveness of the algorithm was demonstrated by designing a number of truss structures with as many as four hundred and eighty nine design variables. The algorithm is extremely stable and in all cases the optimum designs were obtained in less than twenty iterations regardless of the size of the structure and the number of design variables.

# A87-33591# ROBUSTNESS OPTIMIZATION OF STRUCTURAL AND CONTROLLER PARAMETERS

KYONG B. LIM (Virginia Polytechnic Institute and State University, Blacksburg) and JOHN L. JUNKINS (Texas A & M University, College Station) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1987, p. 351-361. refs (Contract F49620-86-K-0014) (AIAA PAPER 87-0791)

A unified approach to structure and controller design optimization is presented showing several novel ideas in the definition and optimization of robustness for structures and structural controllers. A robustness bound due to Patel and Toda is developed using conditioning analysis of the closed loop eigenvalue problem. Homotopy and sequential linear programming algorithms are used, in lieu of conventional nonlinear programming, to implement these ideas for an illustrative example. The numerical results confirm the conservatism of the stability robustness bound for highly structured perturbations but nevertheless clearly support the hypothesis that maximizing the robustness measure does significantly increase the true robustness of a closed loop system.

# A87-33610\*# Tokyo Univ. (Japan). SIMULTANEOUS STRUCTURE/CONTROL OPTIMIZATION OF LARGE FLEXIBLE SPACECRAFT

JUNJIRO ONODA (Tokyo, University, Japan) and RAPHAEL T. HAFTKA (Virginia Polytechnic Institute and State University, Blacksburg) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987, Technical Papers. Part 1 New York, American Institute of Aeronautics and Astronautics, 1987, p. 501-507. refs (Contract NAG1-224)

(AIAA PAPER 87-0823)

This paper presents an approach to the simultaneous optimal design of a structure and control system for large flexible spacecrafts based on realistic objective function and constraints. The weight or total cost of structure and control system is minimized subject to constraints on the magnitude of response to a given disturbance involving both rigid-body and elastic modes. A nested optimization technique is developed to solve the combined problem. As an example, simple beam-like spacecraft under a steady-state white-noise disturbance force is investigated and some results of optimization are presented. In the numerical examples, the stiffness distribution, the location of controller and the control gains are optimized. Direct feedback control and linear quadratic optimal control laws are used with both inertial and non-inertial disturbing force. It is shown that the total cost is sensitive to the overall structural stiffness so that a simultaneous optimization of the Author structure and control system is indeed useful.

**A87-33611\***# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

INTEGRATED STRUCTURAL ELECTROMAGNETIC
OPTIMIZATION OF LARGE SPACE ANTENNA REFLECTORS

S. L. PADULA, H. M. ADELMAN, and M. C. BAILEY (NASA, Langley Research Center, Hampton, VA) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1987, p. 508-517. refs (AIAA PAPER 87-0824)

The requirements for extremely precise and powerful large space antenna reflectors have motivated the development of a procedure for shape control of the reflector surface. A mathematical optimization procedure has been developed which improves antenna performance while minimizing necessary shape correction effort. In contrast to previous work which proposed controlling the rms distortion error of the surface thereby indirectly improving antenna performance, the current work includes electromagnetic (EM) performance calculations as an integral part of the control procedure. The application of the procedure to a radiometer design with a tetrahedral truss backup structure demonstrates the potential for significant improvement. The results indicate the benefit of including EM performance calculations in procedures for shape control of large space antenna reflectors.

**A87-33613\*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

OPTIMIZATION PROCEDURE TO CONTROL THE COUPLING OF VIBRATION MODES IN FLEXIBLE SPACE STRUCTURES

JOANNE L. WALSH (NASA, Langley Research Center, Hampton, VA) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1987, p. 525-534. refs (AIAA PAPER 87-0826)

As spacecraft structural concepts increase in size and flexibility, the vibration frequencies become more closely-spaced. The identification and control of such closely-spaced frequencies present a significant challenge. To validate system identification and control methods prior to actual flight, simpler space structures will be flown. To challenge the above technologies it will be necessary to design these structures with closely-spaced or coupled vibration modes. Thus there exists a need to develop a systematic method to design a structure which has closely-spaced vibration frequencies. This paper describes an optimization procedure which is used to design a large flexible structure to have closely-spaced vibration frequencies. The procedure uses a general-purpose finite-element analysis program for the vibration and sensitivity analyses and a general-purpose optimization program. Results are presented from two studies. The first study uses a detailed model of a large flexible structure to design a structure with one pair of closely-spaced frequencies. The second study uses a simple equivalent beam model of a large flexible structure to obtain a design with two pairs of closely-spaced frequencies. Author

#### A87-33632#

## NEW CONCEPTS OF DEPLOYABLE TRUSS UNITS FOR LARGE SPACE STRUCTURES

KIYOSHI TAKAMATSU (Fuji Heavy Industries, Ltd., Tochigi, Japan), JUNJIRO ONODA (Tokyo, University, Japan), and KEN HIGUCHI (Tokyo University of Electrical Engineering, Saitama, Japan) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1987, p. 695-704. refs

(AIAA PAPER 87-0868)

Concepts of two types of newly proposed deployable hexahedral truss units are presented. One of them, which is called Sliding Hinge Double Fold (SHDF), is the concept which is suitable for the application to the macroscopic two- or three-dimensional structures, while the other, which is called Sliding Hinge Single Fold (SHSF), for the application to the macroscopic one

dimensional structures. Comparative study with existing deployable concepts indicates that both concepts can achieve almost the same or in some cases better packaging efficiency with fewer mechanisms for the truss to be folded. Function models were fabricated and tested to demonstrate the kinematic consistency of the concepts. Feasibility study of the application of SHDF to a large antenna structure is also performed. The finite element calculations were carried out to investigate effects of some design parameters on dynamic characteristics of two-dimensional platforms consisting of SHDF.

**A87-33633\***# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

#### QUASI-STATIC SHAPE ADJUSTMENT OF A 15 METER DIAMETER SPACE ANTENNA

W. KEITH BELVIN, CATHERINE L. HERSTROM (NASA, Langley Research Center, Hampton, VA), and HAROLD H. EDIGHOFFER (Edighoffer, Inc., Newport News, VA) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1987, p. 705-713. refs (AIAA PAPER 87-0869)

A 15 meter diameter Hoop-Column antenna has been analyzed and tested to study shape adjustment of the reflector surface. The Hoop-Column antenna concept employs pretensioned cables and mesh to produce a paraboloidal reflector surface. Fabrication errors and thermal distortions may significantly reduce surface accuracy and consequently degrade electromagnetic performance. Thus, the ability to adjust the surface shape is desirable. The shape adjustment algorithm consisted of finite element and least squares error analyses to minimize the surface distortions. Experimental results verified the analysis. Application of the procedure resulted in a reduction of surface error by 38 percent. Quasi-static shape adjustment has the potential for on-orbit compensation for a variety of surface shape distortions. Author

A87-33634\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

## ON ORBIT DAMAGE ASSESSMENT FOR LARGE SPACE STRUCTURES

JAY-CHUNG CHEN and JOHN A. GARBA (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1987, p. 714-721. refs (Contract NAS7-918)

(AIAA PAPER 87-0870)

The need for monitoring the dynamic characteristics of large structural systems, for the purpose of assessing the potential degradation of structural properties, has been established. This paper develops a theory for assessing the occurrence, location, and extent of potential damage utilizing on-orbit response measurements. The feasibility of the method is demonstrated using a simple structural system as an example.

Author

#### A87-33635#

## DESIGN CONSIDERATIONS FOR A ONE-KILOMETER ANTENNA STICK

JANET E. FREEMAN (Hughes Aircraft Co., Space and Communications Group, El Segundo, CA) and CHARLES D. BABCOCK (California Institute of Technology, Pasadena) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1987, p. 722-727

(AIAA PAPER 87-0871)

Truss design equations for a large space structure are developed, using beam theory, from position knowledge accuracy requirements imposed on the structure. The maximum allowable spacing between position sensing points on the structure can be found by iteration. The underlying static structural analysis assumes a uniform transverse acceleration acting on the structure.

Calculations for the design of a three-longeron truss are demonstrated for a satellite antenna stick with a required position knowledge accuracy of 0.5 cm.

Author

A87-33636\*# California Inst. of Tech., Pasadena.

IDENTIFICATION OF THE ZERO-G SHAPE OF A SPACE BEAM GARY J. BALAS and CHARLES D. BABCOCK (California Institute of Technology, Pasadena) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1987, p. 728-736. Research supported by the California Institute of Technology and NASA. (AIAA PAPER 87-0872)

This paper develops an approach for identifying the 0-g shape of a beam/column in a 1-g environment. The determination of the 0-g shape is accomplished by a combination of experiment and analysis. A prototype large space structure beam/column is scaled to laboratory size to demonstrate that the 0-g shape of the structure can be accurately determined in a ground based experiment information obtained from the 0-g shape experiment is also used to experimentally measure the stiffness of the beam model.

Author

#### A87-33654

STRUCTURES, STRUCTURAL DYNAMICS AND MATERIALS CONFERENCE, 28TH, MONTEREY, CA, APR. 6-8, 1987 AND AIAA DYNAMICS SPECIALISTS CONFERENCE, MONTEREY, CA, APR. 9, 10, 1987, TECHNICAL PAPERS. PARTS 2A & 2B Conferences sponsored by AIAA, ASME, ASCE, and AHS. New York, American Institute of Aeronautics and Astronautics, 1987. Pt. 2A, 585 p.; pt. 2B, 572 p. For individual items see A87-33655 to A87-33761.

Papers are presented on an aeroelatic analysis of launch vehicles in transonic flight, the dynamical response to pulse excitations in large space structures, an analytical flutter investigation of a composite propfan model, and an analysis of Intelsat V flight data. Also considered are the effective stiffness of a structural component under parametric dynamic loading, the effect of nonlinearities on the dynamic response of a large Shuttle payload, and active suppression of an apparent shock induced instability. Other topics include positive position feedback control for large space structures, a flutter analysis of aeronautical composite structures by an improved supersonic kernel function method, and aeroelastic characteristics of swept circulation control wings. Papers are also presented on dynamic and attitude control characteristics of an International Space Station, wave propagation in periodic truss structures, and the hingeless rotor response to random gusts in forward flight.

A87-33658\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

## DYNAMICAL RESPONSE TO PULSE EXCITATIONS IN LARGE SPACE STRUCTURES

MICHAIL ZAK (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2A. New York, American Institute of Aeronautics and Astronautics, 1987, p. 31-39. refs (Contract NAS7-918)

(AIAA PAPER 87-0710)

Finite dimensional approximations of large space structures as distributed parameter systems may lead to a loss of contribution of high frequencies to the dynamic response in case of impulsive or concentrated loads. It is shown that the unmodeled part of this response can be represented by a system of thin pulses which propagate as characteristic waves. It is demonstrated that the dynamical response to such a system of pulses can be modeled by a system of equations with delay argument. Fundamental dynamical properties of this system such as Liapunov stability, structural stability, loss of periodicity and transition to ergodicity are analyzed in this study. The results are illustrated by examples.

#### A87-33669#

#### AN IDENTIFICATION METHOD FOR FLEXIBLE STRUCTURES

NELSON G. CREAMER and JOHN L. JUNKINS (Texas A & M University, College Station) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1967 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2A. New York, American Institute of Aeronautics and Astronautics, 1987, p. 163-171. refs (AIAA PAPER 87-0745)

A structural model identification method is developed for determination of the mass and stiffness matrices of an undamped structure along with the damping matrix of a lightly-damped structure. Utilizing measurements of natural frequencies, damping factors, and frequency response elements, a unique identification of the model is established through incorporation of the spectral decomposition of the frequency response function and the modal orthonormality conditions. Numerical simulations demonstrate the flexibility and potential of the proposed method.

**A87-33670\***# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

# SYSTEM IDENTIFICATION OF A TRUSS TYPE SPACE STRUCTURE USING THE MULTIPLE BOUNDARY CONDITION TEST (MBCT) METHOD

C. P. KUO and B. K. WADA (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2A. New York, American Institute of Aeronautics and Astronautics, 1987, p. 172-176. refs (AIAA PAPER 87-0746)

Experimental results on the application of the multiple boundary condition test (MBCT) method to experimental hardware have validated its usefulness in the ground testing of large flexible space structures. Excellant results were obtained with a beam with a uniform cross-section and with a beam consisting of two different cross-sections alternately located. The MBCT method is then applied to a 12 bay MAST type structure which is part of the NASA COFS program, and the cross-sectional area of the updated mathematical model was found to be within 4.5 percent of the true value.

#### A87-33679#

#### ANALYSIS OF INTELSAT V FLIGHT DATA

T. RUSH, P. R. SCHRANTZ (COMSAT Laboratories, Clarksburg, MD), and B. AGRAWAL (INTELSAT, Washington, DC) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2A . New York, American Institute of Aeronautics and Astronautics, 1987, p. 253-257. COMSAT-INTELSAT-sponsored research.

#### (AIAA PAPER 87-0784)

This paper summarizes results of an extensive evaluation of the Intelsat V spacecraft flight data carried out by COMSAT Laboratories for INTELSAT. A structural loads data base for the Intelsat V was assembled including actual flight measurements, coupled loads analysis predictions, and environmental test loads. The flight measurements incorporate both accelerometer and strain gauge signals transmitted during eight Atlas/Centaur and two Ariane launches of the Intelsat V satellites. An evaluation of the loads data base placed primary emphasis on a comparison of coupled loads analysis predictions with statistically based flight loads. The predictions of axial acceleration at the spacecraft/launch vehicle interface were found to be accurate. However, the lateral loads predicted by the coupled loads analysis were overly conservative. Several discrepancies between the structural analysis and the flight measurements have been revealed. The influence of the spacecraft's dynamic characteristics on interface motions can be readily observed in the data. Author

**A87-33689\***# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

# EXPERIENCE IN DISTRIBUTED PARAMETER MODELING OF THE SPACECRAFT CONTROL LABORATORY EXPERIMENT (SCOLE) STRUCTURE

L. W. TAYLOR and D. S. NAIDU (NASA, Langley Research Center, Hampton, VA) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2A. New York, American Institute of Aeronautics and Astronautics, 1987, p. 330-343. refs (AIAA PAPER 87-0895)

The Spacecraft Control Laboratory Experiment (SCOLE) configuration is used to compare exact and approximate solutions of the partial differential equations which define its structural dynamics. The need for a proof model for evaluating competing control laws demands that solutions be generated which not only exhibit accurate modal characteristics, but precise static deflections as well. Because precise pointing is required, the motion of the end bodies of the Shuttle-attached antenna must be known with great accuracy. Modal models are attractive because of their stable solutions but require hundreds of modes to obtain a static deflection accuracy of only one percent. Although proportional damping in bending agrees well with experimental results using the SCOLE experimental apparatus, modes which involve both torsion and bending differ significantly from proportional damping. A lumped mass model is used to generate exact static deflections, but only approximate modal characteristics. Asymptotic solutions to the distributed parameter system approximate very accurately the modal characteristics at high mode numbers. Ways are examined for refining the approximate solutions by applying a first-order variation and by employing singular perturbation techniques which are usually limited to ordinary differential equations. The most accurate solutions of the distributed parameter model of SCOLE are obtained by combining exact and asymptotic solutions.

Author

A87-33706\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

### ON THE CONTROL OF FLEXIBLE STRUCTURES BY APPLIED THERMAL GRADIENTS

D. L. EDBERG (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2A. New York, American Institute of Aeronautics and Astronautics, 1987, p. 544-550. refs (AIAA PAPER 87-0887)

Thermal, elastic, and feedback analyses are applied to the case of a beam with a distributed thermal actuator. The actuator is capable of producing a thermal gradient across the section of the beam. One candidate for such an actuator uses the Peltier effect, which appears in certain semiconductors. These devices act as heat pumps when a voltage is applied, causing a temperature gradient. It is shown that the thermal gradients can induce deflection in the beam. If the thermal gradients are applied in the proper sense to a vibrating beam, it is possible to increase the vibration damping exhibited by the structure. Experimental results are given for a cantilever beam, whose first vibrational mode damping ratio was increased from 0.81 to 7.4 percent with a simple lead compensation.

# A87-33708\*# Texas A&M Univ., College Station. DYNAMIC RESPONSE OF A VISCOELASTIC TIMOSHENKO REAM

S. KALYANASUNDARAM, D. H. ALLEN, and R. A. SCHAPERY (Texas A & M University, College Station) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AlAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2A. New York, American Institute of Aeronautics and Astronautics, 1987, p. 559-567. refs (Contract NAG9-140) (AlAA PAPER 87-0890)

The analysis presented in this study deals with the vibratory response of viscoelastic Timoshenko (1955) beams under the assumption of small material loss tangents. The appropriate method of analysis employed here may be applied to more complex structures. This study compares the damping ratios obtained from the Timoshenko and Euler-Bernoulli theories for a given viscoelastic material system. From this study the effect of shear deformation and rotary inertia on damping ratios can be identified. Author

#### A87-33709\*# Boeing Aerospace Co., Seattle, Wash. NONLINEAR TRANSIENT ANALYSIS OF JOINT DOMINATED **STRUCTURES**

J. M. CHAPMAN, F. H. SHAW, and W. C. RUSSELL (Boeing Aerospace Co., Seattle, WA) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2A . New York, American Institute of Aeronautics and Astronautics, 1987, p. 568-577. (Contract NAS8-36420)

(AIAA PAPER 87-0892)

A residual force technique is presented that can perform the transient analyses of large, flexible, and joint dominated structures. The technique permits substantial size reduction in the number of degrees of freedom describing the nonlinear structural models and can account for such nonlinear joint phenomena as free-play and hysteresis. In general, joints can have arbitrary force-state map representations but these are used in the form of residual force maps. One essential feature of the technique is to replace the arbitrary force-state maps describing the nonlinear joints with residual force maps describing the truss links. The main advantage of this replacement is that the incrementally small relative displacements and velocities across a joint are not monitored directly thereby avoiding numerical difficulties. Instead, very small and 'soft' residual forces are defined giving a numerically attractive form for the equations of motion and thereby permitting numerically stable integration algorithms. The technique was successfully applied to the transient analyses of a large 58 bay, 60 meter truss having nonlinear joints. A method to perform link testing is also presented.

#### A87-33711\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. POSITIVE POSITION FEEDBACK CONTROL FOR LARGE SPACE STRUCTURES

J. L. FANSON (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) and T. K. CAUGHEY (California Institute of Technology, Pasadena) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2B . New York, American Institute of Aeronautics and Astronautics, 1987, p. 588-598. refs (AIAA PAPER 87-0902)

A new technique for vibration suppression in large space structures is investigated in laboratory experiments on a thin cantilever beam. This technique, called Positive Position Feedback. makes use of generalized displacement measurements to accomplish vibration suppression. Several features of Positive Position Feedback make it attractive for the large space structure control environment: The realization of the controller is simple and straightforward. Global stability conditions can be derived which are independent of the dynamical characteristics of the structure being controlled, i.e., all spillover is stabilizing. The method cannot be destabilized by finite actuator dynamics, and the technique is amenable to a strain-based sensing approach. The experiments control the first six bending modes of a cantilever beam, and make use of piezoelectric materials for actuators and sensors, simulating a piezoelectric active-member. The modal damping ratios are increased by factors ranging from 2 to 130. Author

A87-33712\*# Virginia Polytechnic Inst. and State Univ., Blacksburg. SPILLOVER STABILIZATION AND DECENTRALIZED MODAL **CONTROL OF LARGE SPACE STRUCTURES** 

Polytechnic Institute and State University, Blacksburg) Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2B. New York, American Institute of Aeronautics and Astronautics, 1987, p. 599-609. refs (Contract NAG1-603)

EVA A. CZAJKOWSKI and ANDRE PREUMONT (Virginia

(AIAA PAPER 87-0903)

The stabilization of the neglected dynamics of the higher modes of vibration in large space structures is studied, and the influence of the structure of the plant noise intensity matrix of the Kalman-Bucy filter on the stability margin of the residual modes is shown. An optimization procedure uses information on the residual modes to minimize spillover of known residual modes while preserving robustness with respect to the unknown dynamics, and the optimum plant noise intensity matrix is selected to maximize the stability margins of the residual modes and to properly place the observer poles. Examples for both centralized and decentralized control are considered.

#### A87-33727#

#### MODAL ANALYSES OF DYNAMICS OF A DEFORMABLE MULTIBODY SPACECRAFT - THE SPACE STATION: A CONTINUUM APPROACH

HARI B. HABLANI (Rockwell International Corp., Satellite Systems Div., Seal Beach, CA) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2B . New York, American Institute of Aeronautics and Astronautics, 1987, p. 753-768. refs (AIAA PAPER 87-0925)

Two classes of modes for multibody deformable spacecraft which are completely free in space are formulated: (1) internal rigid body degrees of freedom (IRB) unconstrained modes, referring to free hinges; and (2) IRB-constrained modes, referring to locked hinges. A continuum formulation of the dynamics of the Space Station with a mobile manipulator is presented, and discretized equations of motion of the Space Station are obtained using both modes. Modal moment coefficients of both modes represent the linear and angular momentum of the vehicle and the angular momentum of the hinged bodies. The analysis is general, with elastic deformation being three-dimensional, and structures being of arbitrary geometry and obeying Hooke's law of elasticity. R.R.

#### A87-33737# STRUCTURAL AND CONTROL OPTIMIZATION OF SPACE **STRUCTURES**

N. S. KHOT, V. B. VENKAYYA (USAF, Flight Dynamics Laboratory, Wright-Patterson, AFB, OH), and R. V. GRANDHI (Wright State University, Dayton, OH) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2B . New York, American Institute of Aeronautics and Astronautics, 1987, p. 850-860. USAF-supported research. refs

(AIAA PAPER 87-0939)

Results are obtained by three optimization algorithms to design the structure and control system with weight as the objective function and constraints on the closed-loop eigenvalue distribution and the damping parameters. The nonunique nature of the optimizations is discussed, and the minimization of the Frobenious norm is investigated. A two bar truss and an ACOSS-four structure were designed, and from numerical comparisons it is found that when the structure is completely constrained, minimization of the weight and the Frobenious norm both give identical results. Qualitative aspects of the optimum solutions are considered with the transient response and control effort simulations.

A87-33739\*# PRC Kentron, Inc., Hampton, Va. EFFECTS OF LOCAL VIBRATIONS ON THE DYNAMICS OF **SPACE TRUSS STRUCTURES** 

E. MCGOWAN (NASA, Langley Research Center, Hampton, VA) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2B. New York, American Institute of Aeronautics and Astronautics, 1987, p. 868-875.

(AIAA PAPER 87-0941)

The paper discusses the influence of local member vibrations on the dynamics of repetitive space truss structures. Several focus problems wherein local member vibration modes are in the frequency range of the global truss modes are discussed. Special attention is given to defining methods that can be used to identify the global modes of a truss structure amidst many local modes. Significant interactions between the motions of local member vibrations and the global behavior are shown to occur in truss structures when: (1) the natural frequencies of the individual members for clamped-clamped boundary conditions are in the vicinity of the global truss frequency; and (2) the total mass of the individual members represents a large portion of the mass of the whole structure. The analysis is carried out with a structural analysis code which uses exact member theory. The modeling detail required using conventional finite element codes to adequately represent such a class of problems is examined. The paper concludes with some practical considerations for the design and dynamic testing of structures which might exhibit such behavior.

A87-33741# AN EXPERIMENTAL STUDY OF TRANSIENT WAVES IN A PLANE GRID STRUCTURE

WILLIAM L. HALLAUER, JR. and DINESH J. TRIVEDI (Virginia Polytechnic Institute and State University, Blacksburg) Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2B New York, American Institute of Aeronautics and Astronautics, 1987, p. 888-899. refs

(Contract F49620-85-C-0024)

(AIAA PAPER 87-0943)

Flexural waves were generated and measured in a two-dimensional laboratory structure which is dynamically representative in many respects of flexible large spacecraft structures. The structure's first vibration mode is at 0.6 Hz, and its average modal density for 0-100 Hz is 0.55 mode/Hz. The excitation used was suddenly applied sinusoidal forcing at a point on the structure, with frequencies of 30, 60, 120 and 240 Hz. Time series motion responses were measured at several points on the structure, permitting observation of the wavefront traveling outward from the point of excitation. Complementary theoretical transient responses were computed for a refined finite element model of the laboratory structure, and the theoretical predictions are compared with the experimental measurements.

A87-33742# WAVE PROPAGATION IN PERIODIC TRUSS STRUCTURES

A. H. VON FLOTOW (MIT, Cambridge, MA) and JOEL SIGNORELLI IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2B . New York, American Institute of Aeronautics and Astronautics, 1987, p. 900-909. refs

(AIAA PAPER 87-0944)

Wave propagation in periodic truss-work structures is analytically investigated. Transfer matrix methods are applied to the analysis of a truss beam. The results, with members modeled as rods with pinned joints, agree well with results obtained from an equivalent continuum model of the same structure. Use of beam models for the members, including bending, shows that the pinned rod model loses fidelity above the first resonant frequency of lateral motion of the members. The truss, modeled with beam members exhibits complicated mechanical filtering properties. Fixed and free boundary conditions are converted to reflection matrices. The phase closure principle is invoked to predict natural frequencies

of a fixed-free portion of the truss. It is found that closely spaced resonant frequencies are not identified by this method. Computed results show subtle erroneous characteristics which are attributed to numerical effects.

#### A87-33745# LOCALIZATION OF VIBRATIONS IN LARGE SPACE **REFLECTORS**

ODDVAR O. BENDIKSEN (Princeton University, NJ) and PHILLIP J. CORNWELL IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2B . New York, American Institute of Aeronautics and Astronautics, 1987, p. 925-935. refs

(AIAA PAPER 87-0949)

A study is presented of the mode localization phenomenon in a generic class of large space reflectors. The study is based on a Rayleigh-Ritz formulation using the first five cantilevered beam bending modes and a finite element formulation using Bernoulli-Euler beam elements. Coupling between the structures is provided by massless axial members. Numerical results indicate that mode localization does in fact occur in engineering structures of this type. Localization is characterized by the amplitude of a global mode becoming confined to a local region of the structure. For the 18-rib reflector studied, the first rib bending mode did not localize but the second and third modes did. Localization is found to become more severe with increasing mode number. Increasing the number of ribs to 48 resulted in significant distortion in some of the first rib bending modes and severe localization of the second and third bending modes. The phenomenon of wave confinement in finite structures is also demonstrated using a single-degree-of-freedom per substructure model.

#### A87-33751# OPTIMAL VIBRATION CONTROL BY THE USE OF PIEZOCERAMIC SENSORS AND ACTUATORS

S. HANAGUD, A. J. CALISE (Georgia Institute of Technology, Atlanta), and M. W. OBAL IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2B . New York, American Institute of Aeronautics and Astronautics, 1987, p. 987-997. refs (AIAA PAPER 87-0959)

In this paper, a discrete degrees of freedom model has been formulated for a structural dynamic system consisting of a linear elastic structure, bonded piezoceramic sensors and actuators and a feedback signal conditioning system. The formulated analytical model has been used to develop a procedure for optimum control by minimizing a quadratic performance index of state and control vectors using limited state feedback. An example of a linear elastic beam with piezoceramic sensors and actuators occupying discrete subdomains of the beam upper and lower surfaces has been used to illustrate the developed optimal control procedure. A model for the linear elastic beam has been obtained by using test results and a structural dynamic system identification method based on an equation error approach.

Jet Propulsion Lab., California Inst. of Tech., A87-33752\*# Pasadena.

#### ON SINE DWELL OR BROADBAND METHODS FOR MODAL **TESTING**

JAY-CHUNG CHEN and BEN K. WADA (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2B New York, American Institute of Aeronautics and Astronautics, 1987, p. 998-1004. refs

(Contract NAS7-918)

(AIAA PAPER 87-0961)

For large, complex spacecraft structural systems, the objectives of the modal test are outlined. Based on these objectives, the comparison criteria for the modal test methods, namely, the broadband excitation and the sine dwell methods are established. Using the Galileo spacecraft modal test and the Centaur G Prime upper stage vehicle modal test as examples, the relative advantages or disadvantages of each method are examined. The usefulness or shortcoming of the methods are given from a practicing engineer's view point.

#### A87-33754#

# A MODERN APPROACH FOR MODAL TESTING USING MULTIPLE INPUT SINE EXCITATION

DAVID L. HUNT (SDRC, Inc., San Diego, CA) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2B. New York, American Institute of Aeronautics and Astronautics, 1987, p. 1016-1023. refs

(AIAA PAPER 87-0964)

Sinusoidal excitation continues to be the method preferred by many companies for conducting modal tests of structures. Frequency-response-based modal analysis has been made popular and shown to be quite accurate through the use of multiple input random excitation. A multiple input sine excitation capability has been developed and implemented which retains the benefits associated with both normal mode testing and frequency response function measurement and analysis. A digitally based system has replaced analog/manual force appropriation and control with a multichannel system that automates both exciter control and data acquisition. Other important aspects of the system include determination of force appropriation, informative graphic displays, and system portability.

A87-33755\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

# OPTIMAL PLACEMENT OF EXCITATIONS AND SENSORS FOR VERIFICATION OF LARGE DYNAMICAL SYSTEMS

M. SALAMA, T. ROSE, and J. GARBA (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2B. New York, American Institute of Aeronautics and Astronautics, 1987, p. 1024-1031. refs

(AIAA PAPER 87-0782)

The computationally difficult problem of the optimal placement of excitations and sensors to maximize the observed measurements is studied within the framework of combinatorial optimization, and is solved numerically using a variation of the simulated annealing heuristic algorithm. Results of numerical experiments including a square plate and a 960 degrees-of-freedom Control of Flexible Structure (COFS) truss structure, are presented. Though the algorithm produces suboptimal solutions, its generality and simplicity allow the treatment of complex dynamical systems which would otherwise be difficult to handle.

#### A87-33757#

### LOCALIZATION IN DISORDERED PERIODIC STRUCTURES

GLEN J. KISSEL IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2B. New York, American Institute of Aeronautics and Astronautics, 1987, p. 1046-1055. USAF-supported research. refs

(AIAA PAPER 87-0819)

Disorder in periodic structures is known to cause spatial localization of normal modes and attenuation of waves in all frequency bands. This paper uses a wave perspective to investigate these effects on one-dimensional periodic structures of interest to the engineer. Relevant work in the fields of solid state physics and mathematics is reviewed. A limit theorem for products of random matrices is exploited to calculate localization effects as a function of frequency. Localization is studied on two disordered periodic systems using both theoretical calculations and Monte

Carlo simulations. The problem of localization in multiwave systems is briefly discussed.

Author

#### A87-34467#

# ALTERNATIVE METHODS TO FOLD/DEPLOY TETRAHEDRAL OR PENTAHEDRAL TRUSS PLATFORMS

JUNJIRO ONODA (Tokyo, University, Japan) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 24, Mar.-Apr. 1987, p. 183-186. refs

Deployable tetrahedral and pentahedral truss platforms call for designs minimizing the number of central joints that must be provided with weight-increasing lock mechanisms; this requires the reduction of the number of struts to be folded, extended or contracted. The methods presented accomplish this goal with a 50-percent reduction in total strut number, by making the number of members to be folded or elongated average six per unit module. In addition, the number of face members to be folded or elongated is decreased to one-third that of a conventional truss platform.

O.C.

#### A87-34510#

# COMPARISON OF THE CRAIG-BAMPTON AND RESIDUAL FLEXIBILITY METHODS OF SUBSTRUCTURE REPRESENTATION

DANIEL C. KAMMER and MARY BAKER (Structural Dynamics Research Corp., San Diego, CA) (Structures, Structural Dynamics and Materials Conference, 26th, Orlando, FL, Apr. 15-17, 1985, Technical Papers. Part 2, p. 699-706) Journal of Aircraft (ISSN 0021-8669), vol. 24, April 1987, p. 262-267. Previously cited in issue 13, p. 1900, Accession no. A85-30399. refs

#### A87-34701#

# ON A BALANCED PASSIVE DAMPING AND ACTIVE VIBRATION SUPPRESSION OF LARGE SPACE STRUCTURES

S. S. SIMONIAN, M. S. LUKICH, and R. GLUCK (TRW, Inc., Engineering and Test Div., Redondo Beach, CA) AIAA, Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987. 33 p. refs

(AIAA PAPER 87-0901)

A methodology which blends passive damping and active vibration suppression of large space structures is described. The methodology involves the development of a finite element model of the spacecraft, analysis of the system requirements for the mission, identification of the spacecraft natural modes that require damping augmentation, and the incorporation of damping in the model. Weight cost functions for active and passive suppression systems are developed and compared. The methodology is evaluated by employing it in a laboratory demonstration of a space structure reflecting and/or transmitting electromagnetic radiation. The horizontal displacement and rotation of the simulated mirror are measured by a surface accuracy measurement system. The data from a single vertical column and a complete structure test are analyzed. The control problem is examined and the performance of the open- and closed-loop response characteristics are assessed. It is determined that the modal strain energy methodology is useful for the blending of active and passive damping systems.

#### A87-35327

#### REDUCED MODELING AND ANALYSIS OF LARGE REPETITIVE SPACE STRUCTURES VIA CONTINUUM/DISCRETE CONCEPTS

KUMAR K. TAMMA and KONG C. SAW (West Virginia University, Morgantown) Computers and Structures (ISSN 0045-7949), vol. 25, no. 3, 1987, p. 321-333. refs

The paper describes reduced modeling/analysis approaches for repetitive lattice configurations with emphasis on tetrahedral-type space structures although the basic concepts can be extended to general repetitive lattice structures as well. The approach is based on transforming the actual configuration to a significantly reduced discrete configuration using scaling transformations and constitutive properties derived via the concept of equivalent continuum. The approach seeks to model/analyze

the much simpler and reduced configurations, and transformations and extrapolation/interpolation procedures are utilized to relate back the response to that of the significantly complex actual configurations. The effectiveness and accuracy of the approach is demonstrated via comparisons with detailed analysis of the actual models. Response due to geometric non-linear effects are also evaluated. The overall results obtained are in good agreement with the approach offers potential for further extension. Author

#### A87-36279 COMPARISON OF SATELLITE SUPPORT STRUCTURE ALUMINUM VERSUS GRAPHITE EPOXY

JOSEPH G. LOTTA (Hughes Aircraft Co., Space and Communications Group, El Segundo, CA) SAWE, Annual Conference, 45th, Williamsburg, VA, May 12-14, 1986. 18 p. (SAWE PAPER 1692)

A program is described aimed at achieving minimum-weight hardware for the GOES (Geostationary Operational Environmental Satellite) spacecraft while meeting requirements for load-carrying capability and adequate stiffness, with additional constraints of meeting or surpassing all existing structural and thermal requirements and introducing no redesign of remaining spacecraft elements. The program involved engineering tradeoff and manufacturing development to replace aluminum support structure with graphite/epoxy resin laminates. Manufacturing techniques were developed in-house to lay up a hybrid composite laminate of high-modulus GY-70 and high-strength Celion 3000 and to debulk the layups to eliminate air pockets in a light vacuum bag at room temperature, usually overnight. Proof load tests demonstrated that strength and stiffness requirements were met or improved upon, and a 60 percent weight saving was achieved at a cost of \$27,500 per pound saved (slightly more than half the maximum cost allowed per pound saved).

#### A87-38600 JOINT TECHNOLOGY FOR GRAPHITE EPOXY SPACE STRUCTURES

D. M. MAZENKO, G. A. JENSEN, and P. J. MCCORMICK (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) IN: International SAMPE Technical Conference, 18th, Seattle, WA, Oct. 7-9, 1986, Proceedings. Covina, CA, Society for the Advancement of Material and Process Engineering, 1986, p. 401-413.

Graphite epoxy tubes are commonly used to construct truss assemblies for spacecraft application. The joining of these tubes usually employs metallic end fittings attached to the ends of the tubes. This paper describes tube development, and methods for bonding tubes to aluminum, titanium and silicon carbide/aluminum fittings. Three tube/fitting attachment methods were evaluated: (1) adhesively bonded without fasteners, (2) adhesively bonded with fasteners and (3) attached with fasteners without adhesive. 76 mm (3 in.) diameter tubes constructed of 393 GPa (57 MSI) and 227 GPa (33 MSI) modulus fibers in epoxy prepreg (32 plies) were used to fabricate 305 mm (12 in.) gauge length tensile specimens utilizing the three different end-fitting attachment concepts. The specimens were tested for tensile strength and stiffness in both the as-fabricated condition and after thermal cycling. A combination of adhesive bonding with fasteners produced the highest joint strengths.

#### A87-38601\* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. COMPOSITE TUBES FOR THE SPACE STATION TRUSS

STRUCTURE

DAVID E. BOWLES and DARREL R. TENNEY (NASA, Langley Research Center, Hampton, VA) IN: International SAMPE Technical Conference, 18th, Seattle, WA, Oct. 7-9, 1986, Proceedings Covina, CA, Society for the Advancement of Material and Process Engineering, 1986, p. 414-428. refs

The reference configuration of NASA's Space Station includes a large truss structure to support the various modules and solar arrays. This truss structure will be constructed from tubular members approximately 2 in. in diameter and up to 23 ft in length. The important design considerations for this structure are light

weight, high stiffness, dimensional stability, and long-term durability. Continuous graphite fiber reinforced polymer matrix composite materials can meet the structural requirements, and are leading candidates for the tubular truss members. However, there are concerns regarding the durability of composites during the long-term exposure to atomic oxygen and thermal cycling that will be encountered during the Space Station service life. This paper discusses space environmental factors and their effect on composite materials, and provides estimates of the changes in mechanical and thermal properties of composites exposed to long-term Space Station conditions. The effect of low velocity impact and handling damage on composite tube properties is also discussed.

A87-38609\* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

ASSESSMENT OF SPACE ENVIRONMENT INDUCED MICRODAMAGE IN TOUGHENED COMPOSITE MATERIALS

GEORGE F. SYKES, JOAN G. FUNK, and WAYNE S. SLEMP (NASA, Langley Research Center, Hampton, VA) IN: International SAMPE Technical Conference, 18th, Seattle, WA, Oct. 7-9, 1986, Proceedings. Covina, CA, Society for the Advancement of Material

and Process Engineering, 1986, p. 520-534.

The effects of simulated space environments on the microdamage in a series of commercially available toughened matrix composite systems was determined. Low-earth orbit (LEO) exposures were simulated by thermal cycling; geosynchronous orbit (GEO) exposures were simulated by electron irradiation plus thermal cycling. Material response was characterized by assessing the induced microcracking and its influence on chemical and mechanical property changes. All materials, including several advanced, tough thermoplastics microcracked when exposed to the simulated LEO environment except a 177 C cured single phase toughened epoxy composite. The GEO simulated environment produced microdamage in all materials. The results suggest that increased matrix toughness may not be the overriding factor leading to improved durability in the space environment.

A87-38610\* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

# COMPOSITE SPACE ANTENNA STRUCTURES - PROPERTIES AND ENVIRONMENTAL EFFECTS

C. A. GINTY (NASA, Lewis Research Center, Cleveland, OH) and N. M. ENDRES (Sverdrup Technology, Inc., Middleburg Heights, OH) IN: International SAMPE Technical Conference, 18th, Seattle, WA, Oct. 7-9, 1986, Proceedings. Covina, CA, Society for the Advancement of Material and Process Engineering, 1986, p. 545-560. Previously announced in STAR as N87-16880. refs

The thermal behavior of composite spacecraft antenna reflectors has been investigated with the integrated Composites Analyzer (ICAN) computer code. Parametric studies have been conducted on the face sheets and honeycomb core which constitute the sandwich-type structures. Selected thermal and mechanical properties of the composite faces and sandwich structures are presented graphically as functions of varying fiber volume ratio, temperature, and moisture content. The coefficients of thermal expansion are discussed in detail since these are the critical design parameters. In addition, existing experimental data are presented and compared to the ICAN predictions.

# A87-38612 MEASURING THERMAL EXPANSION IN LARGE COMPOSITE STRUCTURES

GARY C. KRUMWEIDE, DAVID N. CHAMBERLIN, and EDDY A. DERBY (Composite Optics, Inc., San Diego, CA) IN: International SAMPE Technical Conference, 18th, Seattle, WA, Oct. 7-9, 1986, Proceedings . Covina, CA, Society for the Advancement of Material and Process Engineering, 1986, p. 572-582.

A unique laser/comparator measurement method is successfully adapted to the determination of the end-to-end coefficient of thermal expansion of a large telescope metering structure. Used principally for small coupon thermal expansion measurements, this light beam and movable optics technique has been scaled up to

permit measurement of the actual structure to a resolution of 10 to the -7th in/in/deg F. Also discussed is real time design/analysis support during the test program to correct test set-up design problems and to modify the design of the telescope metering structure as indicated by test results.

Author

#### A87-38824#

# APPLICATION OF REANALYSIS TECHNIQUES IN DYNAMIC ANALYSIS OF SPACECRAFT STRUCTURES

F. H. CHU and P. WALKER (RCA/Astro Electronics, Princeton, NJ) IN: Reanalysis of structural dynamic models; Proceedings of the Symposium, Anaheim, CA, Dec. 7-12, 1986. New York, American Society of Mechanical Engineers, 1986, p. 95-104. refs

This paper demonstrates some useful applications of reanalysis techniques to spacecraft structure design. The applications include prediction of the dynamic effects of stiffness and mass changes, optimization of structures subjected to frequency constraints, and model refinement based on modal test data. Software has been developed to integrate the reanalysis formulation with the general purpose finite element software NASTRAN. The time savings and accuracy of the approach is illustrated using a spacecraft, a space truss, and a reflector finite element model as test cases. Author

A87-39543\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

# CONTROL OF FLEXIBLE STRUCTURES BY APPLIED THERMAL GRADIENTS

DONALD L. EDBERG (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) AIAA Journal (ISSN 0001-1452), vol. 25, June 1987, p. 877-883. refs

Thermal, elastic, and feedback analyses are applied to the case of a beam with a distributed thermal actuator. The actuator is capable of producing a thermal gradient across the section of the beam. One candidate for such an actuator uses the Peltier effect, which appears in certain semiconductors. These devices act as heat pumps when a voltage is applied, causing a temperature gradient. It is shown that the thermal gradients can induce deflection in the beam. If the thermal gradients are applied in the proper sense to a vibrating beam, it is possible to increase the vibration damping exhibited by the structure. Experimental results are given for a cantilever beam, whose first vibrational mode damping ratio was increased from 0.81 to 7.4 percent with simple lead compensation.

#### A87-40075#

# INCORPORATION OF THE EFFECTS OF MATERIAL DAMPING AND NONLINEARITIES ON THE DYNAMICS OF SPACE STRUCTURES

E. F. CRAWLEY and K. J. O'DONNELL (MIT, Cambridge, MA) IN: U.S. National Congress of Applied Mechanics, 10th, Austin, TX, June 16-20, 1986, Proceedings . New York, American Society of Mechanical Engineers, 1987, p. 415-420. refs

A procedure is presented for incorporating the distributed material damping effects and discrete nonlinear joint properties of truss structures into a linear analysis technique. A testing apparatus has been constructed which measures the transient response of a truss member in free-fall in a vacuum to obtain its material damping characteristics. The force-state mapping technique is presented for identifying localized nonlinearities in joints by presenting the force transmitted through the joint as a function of the full mechanical state of the joint. The nonlinear structural parameters are then linearized using an equivalent energy approach which finds the equivalent linear stiffness and linear viscous damping of each nonlinearity by equating the integrated average of the work done and energy dissipated by the nonlinearity to those of a spring and damper undergoing sinusoidal motion. Incorporation of both the distributed material damping and localized nonlinear effects is discussed in the context of forming a linearized damped finite element model.

#### A87-40866#

# GRADIENT-BASED COMBINED STRUCTURAL AND CONTROL OPTIMIZATION

DAVID F. MILLER and JAEDONG SHIM (Wright State University, Dayton, OH) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 10, May-June 1987, p. 291-298. Previously cited in issue 07, p. 938, Accession no. A86-19736. refs (Contract F33615-84-C-3217)

#### A87-41052

## MODELING, STABILIZATION AND CONTROL OF SERIALLY CONNECTED BEAMS

G. CHEN, A. M. KRALL (Pennsylvania State University, University Park), M. C. DELFOUR (Montreal, Universite, Canada), and G. PAYRES (Sherbrooke, Universite, Canada) SIAM Journal on Control and Optimization (ISSN 0363-0129), vol. 25, May 1987, p. 526-546. refs

(Contract NSERC-A-8730; NSF DMS-84-01297; AF-AFOSR-85-0253; CDC-24ST-36001-3-1898)

Many flexible structures consist of a large number of components coupled end to end in the form of a chain. In this paper, consideration is given to the simplest type of such structures which is formed by N serially connected Euler-Bernoulli beams, with N actuators and sensors co-located at nodal points. When these N beams are strongly connected at all intermediate nodes and their material coefficients satisfy certain properties, uniform exponential stabilization can be achieved by stabilizing at one end point of the composite beam. Finite elements are used to discretize the partial differential equation and compute the spectra of these boundary damped operators. Numerical results are also illustrated.

A87-41159\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

# EXPERIENCES WITH THE LANCZOS METHOD ON A PARALLEL COMPUTER

SUSAN W. BOSTIC (NASA, Langley Research Center, Hampton, VA) and ROBERT E. FULTON (Georgia Institute of Technology, Atlanta) ASME, International Computers in Engineering Conference and Exhibition, New York, Aug. 9-13, 1987, Paper. 9 p. refs

A parallel computer implementation of the Lanczos method for the free-vibration analysis of structures is considered, and results for two example problems show substantial time-reduction over the sequential solutions. The major Lanczos calculation tasks are subdivided into subtasks, and parallelism is introduced at the subtask level. A speedup of 7.8 on eight processors was obtained for the decomposition step of the problem involving a 60-m three-longeron space mast, and a speedup of 14.6 on 16 processors was obtained for the decomposition step of the problem involving a blade-stiffened graphite-epoxy panel.

#### A87-41574

#### A FORMULATION FOR STUDYING DYNAMICS OF N CONNECTED FLEXIBLE DEPLOYABLE MEMBERS

A. M. IBRAHIM and V. J. MODI (British Columbia, University, Vancouver, Canada) (IAF, International Astronautical Congress on Space: New Opportunities for all People, 37th, Innsbruck, Austria, Oct. 4-11, 1986) Acta Astronautica (ISSN 0094-5765), vol. 16, 1987, p. 151-164.

(Contract NSERC-G-1547)

A relatively general formulation for studying dynamics of a system, consisting of N connected flexible deployable members (beams, plates, shells, membranes, strings) forming a topological tree or a closed configuration, is presented. The mathematical description of the system can be, in general, a combination of discrete and distributed coordinates. Joints, elastic and dissipative, permit relative rotation and translation between bodies. The elastic deformations (lateral, axial, and torsional) can be discretized using admissible functions, finite elements or lumped mass method. Rotations of the members, as well as of the entire system, can be described using a set of orientation angles, Euler parameters or Rodrigues vectors. The formulation accounts for: the presence

of momentum or reaction wheels (gimballed or fixed); thrusters distributed over the flexible and rigid portions; and any prescribed forms of energy dissipation mechanisms. Of course, the generalized forces can simulate desired environmental effects. The formulation is valid for orbiting as well as ground based and marine systems. Application of the formulation is illustrated through several examples, in spacecraft dynamics, which are of contemporary interest.

A87-41613\*# National Aeronautics and Space Administration.
Langley Research Center, Hampton, Va.
DYNAMIC ANALYSIS AND EXPERIMENT METHODS FOR A
GENERIC SPACE STATION MODEL

W. KEITH BELVIN (NASA, Langley Research Center, Hampton, VA) and HAROLD H. EDIGHOFFER (Edighoffer, Inc., Newport News, VA) (Structures, Structural Dynamics and Materials Conference, 27th, San Antonio, TX, May 19-21, 1986, Technical Papers. Part 2, p. 10-18) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 24, May-June 1987, p. 270-276. Previously cited in issue 18, p. 2617, Accession no. A86-38886. refs

A87-42678\*# National Aeronautics and Space Administration.
Langley Research Center, Hampton, Va.
INTERDISCIPLINARY ANALYSIS PROCEDURES IN THE
MODELING AND CONTROL OF LARGE SPACE-BASED

STRUCTURES
PAUL A. COOPER (NASA, Langley Research Center, Hampton, VA), ALAN E. STOCKWELL, and ZEEN C. KIM (PRC Kentron, Inc., Hampton, VA) ASME, Symposium on Engineering Data Management: Critical Issues, New York, Aug. 10-14, 1987, Paper.

The paper describes a computer software system called the Integrated Multidisciplinary Analysis Tool, IMAT, that has been developed at NASA Langley Research Center. IMAT provides researchers and analysts with an efficient capability to analyze satellite control systems influenced by structural dynamics. Using a menu-driven interactive executive program, IMAT links a relational database to commercial structural and controls analysis codes. The paper describes the procedures followed to analyze a complex satellite structure and control system. The codes used to accomplish the analysis are described, and an example is provided of an application of IMAT to the analysis of a reference space station subject to a rectangular pulse loading at its docking port.

A87-44588
PEEK (POLYETHER ETHER KETONE) WITH 30 PERCENT OF CARBON FIBRES FOR INJECTION MOLDING

PAUL HEBRARD and MICHEL PARCELIER (Aerospatiale, Division Systemes Balistiques et Spatiaux, Les Mureaux, France) IN: High tech - The way into the nineties; Proceedings of the Seventh International SAMPE Conference, European Chapter, Munich, West Germany, June 10-12, 1986 . Amsterdam and New York, Elsevier Science Publishers, 1986, p. 187-200. refs

Carbon-fiber-reinforced PEEK injected-mold composites have been developed which reduce weight and cost while optimizing mechanical properties and improving the dimensional stability of injection molding conditions. Attention is presently given to the influence of thermal posttreatment of the resin and the effect of its crystallinity on such aspects of long-term behavior as creep and fatigue properties. The method in question is used to produce a prototype nozzle for a deployable antenna mast, and the various difficulties encountered are discussed.

A87-46793\*# Virginia Polytechnic Inst. and State Univ., Blacksburg.

AN APPROACH TO STRUCTURE/CONTROL SIMULTANEOUS OPTIMIZATION FOR LARGE FLEXIBLE SPACECRAFT

JUNJIRO ONODA and RAPHAEL T. HAFTKA (Virginia Polytechnic Institute and State University, Blacksburg) AIAA Journal (ISSN 0001-1452), vol. 25, Aug. 1987, p. 1133-1138. refs (Contract NAG1-224)

This paper presents an approach to the simultaneous optimal

design of a structure and control system for large flexible spacecrafts based on realistic objective function and constraints. The weight or total cost of structure and control system is minimized subject to constraints on the magnitude of response to a given disturbance involving both rigid-body and elastic modes. A nested optimization technique is developed to solve the combined problem. As an example, simple beam-like spacecraft under a steady-state white-noise disturbance force is investigated and some results of optimization are presented. In the numerical examples, the stiffness distribution, location of controller, and control gains are optimized. Direct feedback control and linear quadratic optimal controls laws are used with both inertial and noninertial disturbing force. It is shown that the total cost is sensitive to the overall structural stiffness, so that simultaneous optimization of the structure and control system is indeed useful.

A87-47327
EVALUATION OF THE BUILT-IN STRESSES AND RESIDUAL DISTORTIONS ON CURED COMPOSITES FOR SPACE ANTENNA REFLECTORS APPLICATIONS

M. MARCHETTI, S. TIZZI (Roma I, Universita, Rome, Italy), and F. MORGANTI (Selenia Spazio S.p.A., Rome, Italy) Composite Structures (ISSN 0263-8223), vol. 7, no. 4, 1987, p. 267-283. Research supported by the Ministero della Pubblica Istruzione.

Manufacturing and thermal distortion RMS is an important dimensional parameter which can be correlated with the antenna performances. For this reason it is used to characterize their allowed dimensional stability in order to guarantee the mission requirements. The antenna reflectors on board of space platforms are generally manufactured with composite materials. The RMS of these structures is very tightly connected with the technologies like curing cycles, kind of materials, lay up tipology, mould configuration etc. The maximum effort is produced to minimize this parameter due to the manufacturing, while the prediction methods able to correlate the residual distortions versus the applied technology can be very useful to optimize the hardware performances.

A87-47809\*# National Aeronautics and Space Administration.
Langley Research Center, Hampton, Va.

EFFECTS OF ATMOSPHERE ON SLEWING CONTROL OF A FLEXIBLE STRUCTURE

JER-NAN JUANG and LUCAS G. HORTA (NASA, Langley Research Center, Hampton, VA) (Structures, Structural Dynamics and Materials Conference, 27th, San Antonio, TX, May 19-21, 1986, Technical Papers. Part 2, p. 613-620) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 10, July-Aug. 1987, p. 387-392. Previously cited in issue 18, p. 2618, Accession no. A86-38942. refs

A87-47812\*# California Univ., Los Angeles.
PERTURBATION ANALYSIS OF INTERNAL BALANCING FOR
LIGHTLY DAMPED MECHANICAL SYSTEMS WITH
GYROSCOPIC AND CIRCULATORY FORCES

P. A. BLELLOCH, D. L. MINGORI, and J. D. WEI (California, University, Los Angeles) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 10, July-Aug. 1987, p. 406-410. refs

(Contract NAS7-918)

Approximate expressions are developed for internally balanced singular values corresponding to the modes of mechanical systems with gyroscopic forces, light damping, and small circulatory forces. A brief overview is first given of the balanced realization model reduction method, including a discussion of recent work. The models considered are defined, and a perturbation analysis is used to show that the modal representation becomes asymptotically balanced as damping reduces to zero. The approximate balanced singular values are calculated, and a simple example of a flexible, dual-spin spacecraft is given as an illustration of the results.

C.D.

#### A87-48341

#### A BASIS CHANGE STRATEGY FOR THE REDUCED GRADIENT METHOD AND THE OPTIMUM DESIGN OF LARGE

K. T. JOSEPH (Indian Space Research Organization, Vikram Sarabha, Space Centre, Trivandrum, India) International Journal for Numerical Methods in Engineering (ISSN 0029-5981), vol. 24, July 1987, p. 1269-1281. refs

The paper proposes a basis change strategy within the reduced gradient method for optimization under linear constraints. It ensures a nonsingular basis matrix at every iteration. The same strategy can reliably be used within the generalized reduced gradient method for optimization under nonlinear constraints. This method is applied to the minimum weight design of large structures under displacement and stress constraints, exploiting the sparsity of the constraint Jacobian matrix.

#### A87-48714#

#### FLEXIBILITY EFFECTS - ESTIMATION OF THE STIFFNESS MATRIX IN THE DYNAMICS OF A LARGE STRUCTURE

M. L. AMIROUCHE (Illinois, University, Chicago) Transactions, Journal of Vibration, Acoustics, Stress, and Reliability in Design (ISSN 0739-3717), vol. 109, July 1987, p. 283-288.

In this paper, an estimation of the stiffness matrix for a mechanical tree-like structure is presented. The coefficients of the stiffness matrix are evaluated based on Kane's equations together with the finite segment modeling technique and matrix structure analysis. The procedure developed is used to evaluate the stiffness coefficients in the case where the flexibility effects are modeled by uniform beam elements with springs and dampers at the connecting joints. The method presented in this paper is very useful in the study of the dynamics, vibration, and control of a large tree-like structuure undergoing large motions. An illustration of how the method is used in extracting the natural frequencies and their corresponding mode shapes is presented. The set of equations developed in this paper are the complement equations used to monitor the transient response of the structure undergoing a rigid-body motion.

#### A87-50232

#### ACTIVE VIBRATION CONTROL OF A SIMPLY SUPPORTED BEAM USING A SPATIALLY DISTRIBUTED ACTUATOR

SHAWN E. BURKE and JAMES E. HUBBARD, JR. (Charles Stark Draper Laboratory, Inc., Cambridge, MA) IEEE Control Systems Magazine (ISSN 0272-1708), vol. 7, Aug. 1987, p. 25-30. Research supported by the Charles Stark Draper Laboratory, Inc. refs

The application of a spatially shaped distributed actuator to the vibration control of a simply supported beam is studied analytically and experimentally with reference to component elements used in large space structures. The actuator consists of a layer of PVF2 bonded to one face of the beam; the requisite film controller has a linearly varying spatial distribution which facilitates the control of both even-order and odd-order vibrational modes, serving to increase the modal loss factors by up to a factor of 4.5. The experimental results are found to corroborate a simplified computer model of the controller.

A87-50416\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

ROBUST EIGENSYSTEM ASSIGNMENT FOR FLEXIBLE

### **STRUCTURES**

JER-NAN JUANG, KYONG B. LIM (NASA, Langley Research Center, Hampton, VA), and JOHN L. JUNKINS (Texas A&M University, College Station) IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1987, p. 117-123. refs (AIAA PAPER 87-2252)

An improved method is developed for eigenvalues and eigenvectors placement of a closed-loop control system using either state or output feedback. The method basically consists of three steps. First, the singular value of QR decomposition is used

to generate an orthonormal basis that spans admissible eigenvector space corresponding to each assigned eigenvalue. Secondly, given a unitary matrix, the eigenvector set which best approximates the given matrix in the least-square sense and still satisfy eigenvalue cosntraints is determined. Thirdly, a unitary matrix is sought to minimize the error between the unitary matrix and the assignable eigenvector matrix. For use as the desired eigenvector set, two matrices, namely, the open-loop eigenvector matrix and its closest unitary matrix are proposed. The latter matrix generally encourages both minimum conditioning and control gains. In addition, the algorithm is formulated in real arithmetic for efficient implementation. To illustrate the basic concepts, numerical examples are included.

#### A87-50442#

#### ACTIVE DAMPING CONTROL DESIGN FOR THE COFS MAST FLIGHT SYSTEM

FREDRIC M. HAM, BEN L. HENNIGES, and SCOTT W. GREELEY (Harris Corp., Government Aerospace Systems Div., Melbourne, FL) IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 1 New York, American Institute of Aeronautics and Astronautics, 1987, p. 354-360.

(AIAA PAPER 87-2321)

Design and development of the Mast Flight System for the COFS (Control of Flexible Structures) program for NASA is currently underway. An active damping controller is required to provide five percent damping for the first ten structural modes of a sixty meter truss beam structure. The baseline control system to provide the required damping is a Positive-Real Decentralized Velocity Feedback (PRDVF) type. Continuous and discrete time designs are presented. The system modeling details are also presented which includes the models for the truss beam and the colocated actuators and sensors.

#### A87-50443#

#### **ACTIVE VIBRATION CONTROL SYNTHESIS FOR THE COFS-I** - A CLASSICAL APPROACH

BONG WIE (Texas, University, Austin) IN: AIAA Guidance. Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1987, p. 361-369. refs (AIAA PAPER 87-2322)

The major findings of a Guest Investigator study of the active vibration control for the NASA Control of Flexible Structures experiment I (COFS-I) are reported. The COFS-I flight structure is briefly characterized; the classical transfer-function approach employed is explained; and consideration is given to pole-zero modeling, proof-mass actuator dynamics, the effect of microprocessor computational delay, a generalized nonminimumphase structural filtering concept using the noncolocated actuator/ sensor. Diagrams and graphs are provided.

#### A87-50444#

#### SUBOPTIMAL FEEDBACK VIBRATION CONTROL OF A BEAM WITH A PROOF-MASS ACTUATOR

W. D. PILKEY (Virginia, University, Charlottesville) and H. POLITANSKY IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1987, p. 370-378. USAF-supported research. refs (AIAA PAPER 87-2323)

A clamped-free beam, damped by a proof-mass actuator, is selected for small scale model research of flexible structures in space. The dynamic behavior of this system is strongly influenced by the constraints on the motion of the proof-mass and by the maximum control forces available. An optimal solution is presented, using a linear programming algorithm. Then, a simplified feedback control is utilized, based on modern control theory, to obtain optimal low-frequency performance, and classical control theory to bound the high-frequency modes. By special consideration of the

constraints, satisfactory control is achieved, even in the nonlinear region when the proof-mass approaches its stops.

#### A87-50445#

# CONTROL OF MULTIPLE-MIRROR/FLEXIBLE-STRUCTURES IN SLEW MANEUVERS

E. BARBIERI, S. YURKOVICH, and U. OZGUNER (Ohio State University, Columbus) IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 1. New York, American Institute of Aeronautics and Astronautics, 1987, p. 379-388. refs (AIAA PAPER 87-2324)

Modeling and control of multiple-mirror/flexible slewing structures is considered. Primary applications for such systems include Line-Of-Sight (LOS) pointing systems on large flexible structures, space telerobotic systems, and space telescope systems. Two stages characterize the modeling problem for this study: (1) the description of the rigid slewing motion and associated mirror and ray optics; and (2) the description of the flexible dynamics. The rigid-motion ray-trace equations are developed by using the compact notation used to describe the motion of robotic manipulators, while flexible dynamics are obtained via standard finite-element techniques. The resulting hybrid model is suitable for analysis in a four stage process: (1) relegation of control tasks (intimately related to the kinematics); (2) the standard slewing control problem; (3) flexibility compensation using mirror actuators; and (4) active vibration damping with additional (proof-mass) actuation. In the present paper the first and third stages of the above process are addressed. An example structure is examined, and control simulations are included for an experimental set-up being developed consisting of a 3-mirror and flexible/slewing beam system.

#### A87-50446#

# A LABORATORY SIMULATION OF FLEXIBLE SPACECRAFT CONTROL

J. A. BOSSI (Boeing Aerospace Co., Seattle, WA) IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 1. New York, American Institute of Aeronautics and Astronautics, 1987, p. 389-394. (AIAA PAPER 87-2325)

A low-cost test structure, including low-frequency lightly-damped modes, some of which have nearly identical frequencies, has been constructed for simulation of some of the control problems expected to arise with large flexible spacecraft. The test structure, floating freely on a flat air-bearing table, combines translational and rotational rigid-body modes with flexible modes. Closed-loop control of the test structure is made possible using discrete displacement measurements, digital control, and pulsed actuation. Preliminary results on flexible mode control are presented, and the spacecraft control simulator is found to be useful in gaining laboratory experience with multivariable control design methods.

#### la-fall: Va

# A87-50471\*# Old Dominion Univ., Norfolk, Va. SINGLE-MODE PROJECTION FILTERS FOR IDENTIFICATION AND STATE ESTIMATION OF FLEXIBLE STRUCTURES

JEN-KUANG HUANG, CHUNG-WEN CHEN (Old Dominion University, Norfolk, VA), and JER-NAN JUANG (NASA, Langley Research Research Center, Hampton, VA) IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 1. New York, American Institute of Aeronautics and Astronautics, 1987, p. 595-604. refs (Contract NAG1-655)

(AIAA PAPER 87-2387)

Single-mode projection filters are developed for eigensystem parameter identification and state estimation from both analytical results and test data. Explicit formulations of these projection filters are derived using the pseudoinverse matrices of the controllabilty and observability matrices in the general sense. A global minimum optimization algorithm is developed to update the filter parameters by using the interval analysis method. Modal parameters can be identified and updated in the global sense within a specified region

of parameters by passing the experimental data through the projection filters. For illustration of this new approach, a numerical example is shown by using a one-dimensional global optimization algorithm to estimate modal frequencies and damping. Author

# A87-50473# SQUARE ROOT STATE ESTIMATOR FOR LARGE SPACE STRUCTURES

YAAKOV OSHMAN and DANIEL J. INMAN (New York, State University, Buffalo) IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 1. New York, American Institute of Aeronautics and Astronautics, 1987, p. 617-627. refs (AIAA PAPER 87-2389)

A square root Kalman filtering algorithm is developed for large space structures, which are modeled by second-order continuous-time finite dynamic models augmented by a discrete-time measurement process. The algorithm is based on the spectral decomposition of the estimation error covariance matrix into its V-Lambda factors, where V is the matrix whose columns are the covariance eigenvectors and Lambda is the diagonal matrix of eigenvalues. The filter consists of a continuous time-update stage and a discrete measurement update stage. In the time-update stage a weighted eigenvector matrix is used instead of using V directly, to avoid the inversion of the mass matrix during the numerical integration process. The measurement update is based on the Singular Valve Decomposition technique. Using the orthogonality property of the covariance eigenvectors, an orthogonalization step is optionally added at the exit from the time-update stage to enhance the filter accuracy.

#### A87-50502#

# A NEW CONCEPT OF GENERALIZED STRUCTURAL FILTERING FOR ACTIVE VIBRATION CONTROL SYNTHESIS

BONG WIE and KUK WHAN BYUN (Texas, University, Austin) IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 2. New York, American Institute of Aeronautics and Astronautics, 1987, p. 919-929. refs

(AIAA PAPER 87-2456)

A new concept of generalized structural filtering and its application to active vibration control synthesis are presented. The concept is a natural extension of the classical notch and phase lead/lag filtering, and emphasizes the use of a nonminimum-phase filter which has zeros in the right-half s-plane. Application of this concept to single-input/single-output systems with many oscillatory modes results in a robust feedback compensator with much physical insight. The concept also enables the control designer to understand the inherent nature of an 'optimal' compensator, and to modify the optimal design to be more robust and meaningful. This paper shows that for certain cases, nonminimum-phase structural filtering provides the proper phase-lag to increase the closed-loop damping of the flexible modes, while maintaining good performance and robustness to parameter variations.

#### A87-50504#

# ADAPTIVE IDENTIFICATION OF FLEXIBLE STRUCTURES BY LATTICE FILTERS

FARYAR JABBARI (California, University, Irvine) and J. S. GIBSON (California, University, Los Angeles) IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 2. New York, American Institute of Aeronautics and Astronautics, 1987, p. 941-949. refs (Contract AF-AFOSR-84-0309) (AIAA PAPER 87-2458)

Recent investigations on lattice filters, and their applications to adaptive identification of flexible structures, are presented. Since the order of the systems cannot be known -or the effective order may change- the order recursiveness of the lattices is of particular interest. Implementation of lattices would permit on-line order determination and would allow the order of the filter to be changed without the need to reprocess the previous data. Experimental data from the flexible grid structure at NASA-Langley are used to

obtain results showing the feasibility of lattices and the advantages that result from their order recursive property. One-step-ahead prediction and estimates for natural frequencies are among the results shown. Of particular interest are the frequency estimates which agree closely with the frequency estimates obtained from off-line identification techniques. The one step-ahead prediction results also show the advantages that lattices provide with their order-determination capability, which would be significant for adaptive control purposes.

**A87-50506\***# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

# DISTRIBUTED PARAMETER MODELING OF THE STRUCTURAL DYNAMICS OF THE SOLAR ARRAY FLIGHT EXPERIMENT

L. W. TAYLOR, JR. and J. L. WILLIAMS (NASA, Langley Research Center, Hampton, VA) IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 2. New York, American Institute of Aeronautics and Astronautics, 1987, p. 959-974. refs (AIAA PAPER 87-2460)

A distributed-parameter model of the structural dynamics of the space-shuttle-deployed Solar Array Flight Experiment is developed and used to produce estimates of the modal frequencies and mode shapes. A lumped parameter version of the distributed model is used to estimate model characteristics by analyzing the measured responses of 32 targets. To make the modeling more tenable, a distributed parameter system is used to reduce the number of unknown parameters, a modified Newton-Raphson technique is used for rapid convergence, and a parallel processing supercomputer is used for more efficient computation. The performances of computers with a high-speed serial processor and with a high-speed parallel processor are compared. The best results are obtained with the modeling approach in which maximum likelihood estimation is applied to distributed parameter models.

R.R.

#### A87-50507#

# PRACTICAL ISSUES IN COMPUTATION OF OPTIMAL, DISTRIBUTED CONTROL OF FLEXIBLE STRUCTURES

W. H. BENNETT (Systems Engineering, Inc., Greenbelt, MD) and H. G. KWATNY (Drexel University, Philadelphia, PA) IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 2. New York, American Institute of Aeronautics and Astronautics, 1987, p. 975-987. refs (Contract F49620-84-C-0115)

(AIAA PAPER 87-2461)

The computation of optimal, distributed state feedback control laws for continuum models arising in flexible space structures is considered. Practical issues are discussed relating to a computational procedure which does not necessarily employ modal or finite element methods for reduced-order modeling as an essential part of the computations. Instead, the frequency response of the distributed parameter system is sampled. The method for computing optimal control laws is based on a Wiener-Hopf problem whose solution involves the solution of an irrational spectral factorization problem. Effective numerical algorithms are discussed and a simple example is given which serves to illustrate the method and some numerical sensitivities associated with the evaluation of certain transcendental terms arising in the frequency response computations.

#### A87-51793

# DEVELOPMENT OF FULL SCALE DEPLOYABLE CFRP TRUSS FOR SPACE STRUCTURE

YOSHIAKI SAKATANI and TETSUYA YAMAMOTO (Mitsubishi Heavy Industries, Ltd., Nagoya Aircraft Works, Japan) IN: Composites '86: Recent advances in Japan and the United States; Proceedings of the Third Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 23-25, 1986. Tokyo, Japan Society for Composite Materials, 1986, p. 693-700.

A design development program has been conducted for deployable truss structures that may serve as spacecraft platforms, antennas, or solar cell panels. The CFRP composite structural elements investigated as bases of these structures encompass hinged, sliding, and flexibly deformable types. The design chosen for structural performance testing employs CFRP tubing, bundled CFRP cable, and titanium alloy hub fittings. Attention is given to prospective synthetic aperture radar, solar cell panel, and sensor mast applications.

#### A87-52966#

## IDENTIFICATION OF LARGE SPACE STRUCTURES - A FACTORIZATION APPROACH

TREVOR WILLIAMS (Kingston Polytechnic, Kingston-upon-Thames, England) (Guidance, Navigation and Control Conference, Williamsburg, VA, Aug. 18-20, 1986, Technical Papers, p.296-302) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 10, Sept.-Oct. 1987, p. 466-473. SERC-supported research. Previously cited in issue 23, p. 3426, Accession no. A86-47432. refs

N87-20307\*# Purdue Univ., West Lafayette, Ind. School of Technology.

## USE OF LIGHTWEIGHT COMPOSITES FOR GAS PAYLOAD STRUCTURES

MARK B. SPENCER In NASA. Goddard Space Flight Center The 1986 Get Away Special Experimenter's Symposium p 31-34 Feb. 1987

Avail: NTIS HC A11/MF A01 CSCL 11D

A key element in the design of a small self-contained payload is the supporting structure. This structure must support the experiments and other components while using as little space and weight as possible. Hence, the structure material must have characteristics of being both strong and light. Aluminum was used for the structure on the first Purdue University payload, but consumed a relatively large percentage of the total payload weight. The current payload has a larger power supply requirement than did the previous payload. To allow additional weight for the batteries, a composite material has been chosen for the structure which has the required strength while being considerably lighter than aluminum. A radial fin design has been chosen for ease of composite material lay-up and its overall strength of design. A composite plate will connect the free ends of the fins and add strength and reduce vibration. The physical characteristics of the composite material and the method of open lay-up construction is described. Also discussed are the testing, modifications, and problems encountered during assembly of the experiments to the structure. Author

# N87-20347 Massachusetts Univ., Amherst. DYNAMIC AND THERMAL EFFECTS IN VERY LARGE SPACE STRUCTURES Ph.D. Thesis

RAMESH-BABU MALLA 1986 326 p Avail: Univ. Microfilms Order No. DA8701196

A mathematical formulation was developed for an axially flexible structure executing a planar motion in a general orbit in space in order to determine dynamic and thermal effects in the structure due to various disturbances in a space environment. The characteristic dimension of the structure is very large (of the order of a few kilometers). The influences of the differential gravitational forces, the radiation heating, and the radiation pressure forces were studied. Effects of these factors were studied on the structure's axial deformation, its attitude motion and its orbit simultaneously. Results are obtained for various initial conditions and physical parameter values. It is observed that the differential gravitational forces do not have any appreciable effects on the structure's axial length and its attitude motion. Thermal effects are significant in producing appreciable structural deformation, and they also affect the attitude motion of the structure considerably. The radiation pressure forces are very significant in changing attitude motion of the space structure, but it causes negligible effects in producing longitudinal deformation of the structure. All of the above factors have insignificant effects on the orbit of the structure chosen in this study. Of all the three external disturbances,

the radiation pressure forces are found to be strongest in affecting the orbit of the structure.

Dissert. Abstr.

N87-20348 Georgia Inst. of Tech., Atlanta.

STUDIES IN NONLINEAR STRUCTURAL DYNAMICS: CHAOTIC BEHAVIOR AND POYNTING EFFECT Ph.D. Thesis

NANDAKISHOR SADASHIV ABHYANKAR 1986 237 p

Avail: Univ. Microfilms Order No. DA8628350

Nonlinear structural dynamics is one of the interdisciplinary fields used to predict and control the vibration of large space structures and flexible bodies. Transient response and steady state vibration constitute two integral parts of the field of structural dynamics. Specific problems consisting of the dynamic coupling of torsional and extensional deformations of a circular cylindrical bar and the chaotic forced vibration of buckled beams are addressed. Equations governing torsional and extensional coupling of waves for a finite hyperelastic cylindrical bar were formulated. Solutions are compared with available exact solutions. The period doubling and chaotic motion were studied for a simply supported buckled beam excited with periodic forcing function. The partial differential equations were solved directly by an explicit, stable finite difference scheme.

N87-20352\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

LARGE SPACE ANTENNAS: A SYSTEMS ANALYSIS CASE HISTORY

LLOYD S. KEAFER, comp. and U. M. LOVELACE, comp. Feb. 1987 19 p

(NASA-TM-89072; NAS 1.15:89072) Avail: NTIS HC A02/MF A01 CSCL 22B

The value of systems analysis and engineering is aptly demonstrated by the work on Large Space Antennas (LSA) by the NASA Langley Spacecraft Analysis Branch. This work was accomplished over the last half-decade by augmenting traditional system engineering, analysis, and design techniques with computer-aided engineering (CAE) techniques using the Langley-developed Interactive Design and Evaluation of Advanced Spacecraft (IDEAS) system. This report chronicles the research highlights and special systems analyses that focused the LSA work on deployable truss antennas. It notes developmental trends toward greater use of CAE techniques in their design and analysis. A look to the future envisions the application of improved systems analysis capabilities to advanced space systems such as an advanced space station or to lunar and Martian missions and human habitats.

N87-20355# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Structures and Materials Panel.

# MECHANICAL QUALIFICATION OF LARGE FLEXIBLE SPACECRAFT STRUCTURES

Jul. 1986 269 p In ENGLISH and FRENCH Meeting held in Oberammergau, West Germany, 9-13 Sep. 1985

(AD-A175529; AGARD-CP-397; ISBN-92-835-0396-1) Avail: NTIS HC A12/MF A01

An account is given of Conference Proceedings of a Specialists' Meeting held by the Structures and Materials Panel in Oberammergau in the Fall of 1985. The problems associated with the mechanical qualification of flexible spacecraft are discussed, and details of relevant methods and techniques are given. The final discussion highlights the difficulties associated with advanced methods of experimental and theoretical dynamic analysis and the handling of larger and larger amounts of data.

N87-20358# Societe Nationale Industrielle Aerospatiale, Cannes (France).

DYNAMIC MODELING AND OPTIMAL CONTROL DESIGN FOR LARGE FLEXIBLE SPACE STRUCTURES

L. PASSERON, CH. GARNIER, and B. SEVENNEC In AGARD Mechanical Qualification of Large Flexible Spacecraft Structures 14 p Jul. 1986

Avail: NTIS HC A12/MF A01

Some advanced results in dynamic modeling and control areas are unifyingly reviewed. Dynamic modeling for complex assemblies of interconnected, rigid or flexible bodies subject to wide relative motions is achieved through a Lagrangian formulation using quasi-coordinates. Lagrange multipliers are explicitly eliminated by way of singular value decomposition resulting in a minimized set of equations. An original software program using element shape functions interfaces the dynamic model with NASTRAN-performed individual substructure analyses. Section 3 summarizes the now classical results in optimal control, while section 4 gives a comprehensive coverage of robustness aspects. Last section is devoted to model order reduction. The internal Balancing Approach is generalized to systems with rigid body modes. Moreover, an error bound between full order and reduced order transfer function is evidenced, which bridges truncation and robustness.

N87-20361\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

STRUCTURAL QUALIFICATION OF LARGE SPACECRAFT

BEN K. WADA In AGARD Mechanical Qualification of Large Flexible Spacecraft Structures 19 p Jul. 1986
Avail: NTIS HC A12/MF A01 CSCL 22A

Over the past twenty-five (25) years of the space program, the major challenge in the structural qualification of the primary structure has shifted from conducting a test that simulated the environment to accurately predicting the structural member loads in flight. Once the flight loads are available, a number of different test methods are used to qualify the structure by subjecting it to the proper loads. The qualification challenge for future large spacecraft will be to adequately predict its dynamic characteristic in space to assure that it can be controlled to meet the mission objectives. A new test concept that may allow acquisition of modal data by ground tests for verification of mathematical models of large flexible space structures which can't be ground tested by conventional methods is discussed.

#### N87-20362# Rome Univ. (Italy). Dipt. Aerospaziale. EFFECT OF MODAL DAMPING IN MODAL SYNTHESIS OF SPACECRAFT STRUCTURES

LUIGI BALIS CREMA and ANTONIO CASTELLANI In AGARD Mechanical Qualification of Large Flexible Spacecraft Structures 11 p Jul. 1986

Avail: NTIS HC A12/MF A01

In the modal synthesis of a large space structure, by a substructuring approach, a focal point is in the evaluation of the modal characteristics of the single components. As a matter of fact it is required to get the non-diagonal terms of the damping substructure matrix to acquire an efficient estimate of the damping characteristics of the whole structure. In this work it has been considered important to understand and to predict the physical causes of complex modes also in an elementary substructure as a sandwich carbon fiber plate. The results of the experimental work indicate that the modal analysis has to be gained in a very tight frequency range, with many averaged data, and the possibility of complex modes is increasing with the increase of the mode order.

N87-20363# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. of Aeroelasticity.

# DYNAMIC QUALIFICATION OF SPACECRAFT BY MEANS OF MODAL SYNTHESIS

A. BERTRAM and P. CONRAD (Messerschmitt-Boelkow-Blohm/ Entwicklungspring Nord, Bremen, West Germany.) In AGARD Mechanical Qualification of Large Flexible Spacecraft Structures 11 p Jul. 1986 Sponsored in part by ESA/ESTEC

Avail: NTIS HC A12/MF A01

The dynamic qualification process is essentially based on tests: verification tests and qualification tests. In order to render ground testing feasible, the structure has to be subdivided into modules. After performing tests on the module level, the dynamic behavior of the entire structure is obtained by modal synthesis. The

experience gained in applying modal synthesis concepts to simple models and spacecraft-type structures is discussed. It is shown that the success of a modal synthesis approach is considerably dependent on the input data, i.e., the results of the modal survey tests. Accordingly, test data requirements are outlined. Finally, the discussion includes the way in which the coupling analyses can be improved by precise consideration of the coupling conditions in substructure tests and calculations.

N87-20364# Centre National d'Etudes Spatiales, Toulouse (France).

#### LOW FREQUENCY VIBRATION TESTING ON SATELLITES

A. GIRARD, A. MAMODE, and F. MERCIER In AGARD Mechanical Qualification of Large Flexible Spacecraft Structures 9 p Jul. 1986 In FRENCH; ENGLISH summary and title Avail: NTIS HC A12/MF A01

Except the well known POGO phenomenon, the low frequency dynamic flight environment for a satellite consists of transient vibrations, mainly thrust transients. The qualification is generally achieved by a sine sweep on a shaker according to contractual specifications. Far from the POGO frequencies and near the main resonant frequencies of the satellite, notchings based on quasi static load criteria or launch vehicle/satellite coupled analysis results are applied to avoid overtesting. However this approach becomes unsatisfactory for complex structures with large appendages, where the initial specifications are widely modified, disturbing the qualification of secondary structures. In order to improve the representativity of these tests, transient vibration testing has been recently investigated. The feasability of such tests on electrodynamic shakers using digital control techniques was demonstrated several years ago and the main problem remaining prior to their operational use has been the definition of an adequate specification for satellite qualification purposes. Several approaches are presented, including shock synthesis, production of a specified transient, and simulation of the launch vehicle impedance. Author

N87-20365# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. of Aeroelasticity.

# MODAL-SURVEY TESTING FOR SYSTEM IDENTIFICATION AND DYNAMIC QUALIFICATION OF SPACECRAFT STRUCTURES

N. NIEDBAL and H. HUENERS In AGARD Mechanical Qualification of Large Flexible Spacecraft Structures 13 p Jul. 1986

Avail: NTIS HC A12/MF A01

Modal-survey testing is an increasingly common part of the qualification procedure for spacecraft structures, since it offers an experimental verification of normal mode parameters determined by dynamic finite-element anlaysis. Moreover, it permits identification of structural damping, knowledge of which is essential for reliable flight-load calculations. A state of the art survey of modern modal-survey testing is given here, covering the phase-resonance method and various phase-separation methods. The use of modal-survey results in the dynamic qualification of spacecraft structures is discussed, emphasizing the correlation of analytical and experimental modal data. This aspect has attracted growing interest in recent years, due to the obvious need for convenient tools that allow finite-element models to be updated with measured modal data.

# N87-20366# Spar Aerospace Ltd., Weston (Ontario). MODAL TESTING OF THE OLYMPUS DEVELOPMENT MODEL STOWED SOLAR ARRAY

S. DRAISEY, M. ELZEKI, A. S. JONES, and G. MARKS In AGARD Mechanical Qualification of Large Flexible Spacecraft Structures 14 p Jul. 1986
Avail: NTIS HC A12/MF A01

The modal testing portion of the structural verification of the stowed solar array configuration of the Olympus S/C, a high powered communication satellite is discussed. The Olympus S/C was designed for both Ariane and Shuttle launches. This versatility

of launch configurations requires an emphasis on the ability to accurately predict loads and structural performance. The stowed array is comprised of: release mechanisms, a tip tensioning mechanism, a stowed astromast and a folded flexible blanket to which solar cells have been mounted. The blanket is held in place between a pallet and pressure plate. The prediction of accurate structural response for such a complicated arrangement from analytical data only would be difficult. Over the past few years Spar has undertaken several development studies in the area of modal analysis. Within these studies a technique, using base excitation of the structure has been established. The use of base input as the excitation for a modal test has provided an economical means of incorporating a modal test into a structural acceptance test procedure.

N87-20367# Politecnico di Milano (Italy). Dipt. di Ingegneria Aerospaziale.

# ACTIVE STRUCTURAL CONTROLLERS EMULATING STRUCTURAL ELEMENTS BY ICUS

AMALIA ERCOLI FINZI, MASSIMILIANO LANZ, and PAOLO MANTEGAZZA /n AGARD Mechanical Qualification of Large Flexible Spacecraft Structures 13 p Jul. 1986 Avail: NTIS HC A12/MF A01

An approach is presented to the active control design of Large Space Structures that is based on the adoption of decentralized control units. These control units use colocated sensors and actuators and adopt a control law that generates forces proportional to local motions in order to emulate real structural elements, discrete tuning masses and grounding spring-damper combinations. Some numerical examples are used to demonstrate the application of the Independent Control Unit (ICU) concept to a beam and a plate for which the active structure controls are obtained by using a suboptimal design procedure. It is shown how the use of this type of control unit allows the development of an intrinsic fail-safe design. The results obtained with the application of the concepts developed here are demonstrated by their application to an experiment in which a thin beam, suspended from the ceiling, is controlled by different combinations of the independent analog control units making use of a velocity trasducer, an integrator and an electrodynamic actuator.

N87-20368# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany). Modal Testing Sect.

# SPACECRAFT QUALIFICATION USING ADVANCED VIBRATION AND MODAL TESTING TECHNIQUES

K. MUEHLBAUER and U. SCHILDT In AGARD Mechanical Qualification of Large Flexible Spacecraft Structures 9 p Jul. 1986

Avail: NTIS HC A12/MF A01

The classical single-shaker vibration test has played a dominant role in the mechanical qualification of flexible spacecraft. Due to the substantially increased payload capacity of modern carrier vehicles the existing test facilities have reached their limits in terms of test article mass and size. These limits are being extended by implementing multi-shaker systems for uni-axial testing. At the same time digital data acquisition and analysis techniques are employed to get a better understanding of the test results and of the test article itself. An alternative approach which overcomes the limitations imposed by the test article size is the analytical qualification. Besides static testing this is in particular supported by modal testing accomplished on system or on sub-system level. For modal testing a broad spectrum of computerized or computer-based techniques is now available which are capable of meeting manifold requirements. The dynamic testing techniques mentioned here are outlined and illustrated using actual examples of installations and applications.

N87-20369# British Aerospace Public Ltd. Co., Stevenage (England). Space and Communications Div.

INFLUENCE CO-EFFICIENT TESTING AS A SUBSTITUTE FOR

MODAL SURVEY TESTING OF LARGE SPACE STRUCTURES
T. F. KEATES /n AGARD Mechanical Qualification of Large

Jul. 1986 Flexible Spacecraft Structures 9 p Avail: NTIS HC A12/MF A01

The American Space Transportation System is capable of placing large payload into low earth orbit. Since the presence of the payload has a significant effect on the behavior of the Shuttle under the low frequency and transient loading during launch and return, a flight loads analysis is performed using a mathematical model of the payload coupled to that of the Shuttle. The process of clearing a payload for launch involves performing this coupled analysis with a validated mathematical model of the payload. This validation usually includes modal survey testing on a structurally representative model which may also be used for static load testing. The advantages and disadvantages of modal survey testing (either fixed base or free/free) and of Static Influence Co-efficient (Flexibility) Testing are discussed. It is concluded that for parts of certain types of payload the latter is a cheaper and sufficient alternative to modal survey testing.

Royal Netherlands Aircraft Factories Fokker, N87-20372# Schiphol-Oost. Space Div.

ACOUSTIC EFFECTS ON THE DYNAMIC OF LIGHTWEIGHT STRUCTURES

J. J. WIJKER In AGARD Mechanical Qualification of Large Flexible Spacecraft Structures 15 p Jul. 1986

Avail: NTIS HC A12/MF A01

The influence of the acoustic effects (surrounding air) on the dynamic behavior of lightweight structures is discussed. Emphasis is given to: the unexpected dynamic characteristics as shown during test; simulation of the acoustic loading within the finite element representation (linear domain); and comparison of the measured dynamic characteristics (modal survey) with the adapted finite element results.

Air Force Flight Dynamics Lab., Wright-Patterson N87-20374# AFB, Ohio.

DEVELOPMENT OF PRECISION STRUCTURAL JOINTS FOR LARGE SPACE STRUCTURES

HAROLD C. CROOP and ANDREW R. ROBERTSON (General In AGARD Mechanical Dynamics Corp., San Diego, Calif.) Qualification of Large Flexible Spacecraft Structures 7 p 1986

Avail: NTIS HC A12/MF A01

Many anticipated future space systems will employ deployable structural assemblies to meet the packaging constraints of the Space transporatation System. Recent developments in deployable structures are described relative to the use of advanced composite materials in the joint designs of such systems. Specific design requirements of interest are dimensional stability, zero free play, minimum weight, and thermal/electrical conductivity through the joints. Several design approaches are presented, along with results Author of material characterization tests.

Virginia Polytechnic Inst. and State Univ., N87-20564 Blacksburg.

MODELING AND CONTROL OF FLEXIBLE STRUCTURES

Ph.D. Thesis JEFFREY KENT BENNIGHOF 1986 137 p

Avail: Univ. Microfilms Order No. DA8625796

Topics in the modeling and control of large flexible structures are examined. In the finite element convergence toward the natural modes and frequencies of a structure, it was found that two mechanisms limiting the accuracy of higher modes, are, first, a decrease in the number of active degrees of freedom for higher mode approximations due to orthogonality constraints, and, second, the fact that lower computed, rather than actual, eigenfunctions appear in the orthogonality constraints, so that inaccuracy in lower modes inhibits convergence to higher modes. Refining the elements using the hierarchial p-version proves to be far superior to refining the mesh, as demonstrated by numerical examples. A method is presented for solving the algebraic eigenvalue problem for a structure, which combines attractive features of the subspace iteration method and the component-mode synthesis methods. The effectiveness of modal control (IMSC) and direct feedback control are investigated for suppressing traveling waves on a string and Dissert. Abstr. on a beam, both with slight material damping.

National Aeronautics and Space Administration. N87-20567\*# Langley Research Center, Hampton, Va.

MODELING OF JOINTS FOR THE DYNAMIC ANALYSIS OF TRUSS STRUCTURES

W. KEITH BELVIN May 1987 43 p

(NASA-TP-2661; L-16163; NAS 1.60:2661) Avail: NTIS HC A03/MF A01 CSCL 20K

An experimentally-based method for determining the stiffness and damping of truss joints is described. The analytical models use springs and both viscous and friction dampers to simulate joint load-deflection behavior. A least-squares algorithm is developed to identify the stiffness and damping coefficients of the analytical joint models from test data. The effects of nonlinear joint stiffness such as joint dead band are also studied. Equations for predicting the sensitivity of beam deformations to changes in joint stiffness are derived and used to show the level of joint stiffness required for nearly rigid joint behavior. Finally, the global frequency sensitivity of a truss structure to random perturbations in joint stiffness is discussed.

National Aeronautics and Space Administration. N87-20568\*# Marshall Space Flight Center, Huntsville, Ala.

SPACE STATION STRUCTURES AND DYNAMICS TEST **PROGRAM** 

CARLETON J. MOORE, JOHN S. TOWNSEND, and EDWARD W. IVEY Mar. 1987 47 p

(NASA-TP-2710; NAS 1.60:2710) Avail: NTIS HC A03/MF A01 CSCL 20K

The design, construction, and operation of a low-Earth orbit space station poses unique challenges for development and implementation of new technology. The technology arises from the special requirement that the station be built and constructed to function in a weightless environment, where static loads are minimal and secondary to system dynamics and control problems. One specific challenge confronting NASA is the development of a dynamics test program for: (1) defining space station design requirements, and (2) identifying the characterizing phenomena affecting the station's design and development. A general definition of the space station dynamic test program, as proposed by MSFC, forms the subject of this report. The test proposal is a comprehensive structural dynamics program to be launched in support of the space station. The test program will help to define the key issues and/or problems inherent to large space structure analysis, design, and testing. Development of a parametric data base and verification of the math models and analytical analysis tools necessary for engineering support of the station's design, construction, and operation provide the impetus for the dynamics test program. The philosophy is to integrate dynamics into the design phase through extensive ground testing and analytical ground simulations of generic systems, prototype elements, and subassemblies. On-orbit testing of the station will also be used to Author define its capability.

Dept. of Aerospace N87-20569\*# Auburn Univ., Ala. Engineering.

INITIAL INVESTIGATIONS INTO THE DAMPING CHARACTERISTICS OF WIRE ROPE VIBRATION ISOLATORS Final Technical Report

M. A. CUTCHINS, J. E. COCHRAN, JR., K. KUMAR, N. G. FITZ-COY, and M. L. TINKER 29 Apr. 1987 89 p (Contract NAG8-532)

(NASA-CR-180698; NAS 1.26:180698) Avail: NTIS HC A05/MF

Passive dampers composed of coils of multi-strand wire rope are investigated. Analytical results range from those produced by complex NASTRAN models to those of a Coulomb damping model with variable friction force. The latter agrees well with experiment. The Coulomb model is also utilized to generate hysteresis loops. Various other models related to early experimental investigations are described. Significant closed-form static solutions for physical properties of single-and multi-strand wire ropes are developed for certain specific geometries and loading conditions. NASTRAN models concentrate on model generation and mode shapes of 2-strand and 7-strand straight wire ropes with interfacial forces.

Autho

N87-20574# Shock and Vibration Information Center (Defense), Washington, D. C.

THE SHOCK AND VIBRATION BULLETIN. PART 1: WELCOME, INVITED PAPERS, SHIPBOARD SHOCK, BLAST AND GROUND SHOCK, SHOCK TESTING AND ANALYSIS

Aug. 1986 297 p Proceedings of the 56th Shock and Vibration Symposium, Monterey, Calif., 22-24 Oct. 1985 (AD-A175224; SVIC-BULL-56-PT-1) Avail: NTIS HC A13/MF A01

Topics addressed include: solid mechanics; shock mechanics; dynamics and control of large space structures; structural dynamic response analysis methods; shipborne shock; blast and ground shock; and shock testing and analysis.

N87-20599# Spar Aerospace Ltd., Ste-Anne-de-Bellevue (Quebec).

OPTIMIZATION OF AEROSPACE STRUCTURES SUBJECTED TO RANDOM VIBRATION AND FATIGUE CONSTRAINTS

V. K. JHA, T. S. SANKAR (Concordia Univ., Montreal, Quebec.), and R. B. BHAT In Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 2: Modal Test and Analysis, Testing Techniques, Machinery Dynamics, Isolation and Damping, Structural Dynamics p 193-200 Aug. 1986
Avail: NTIS HC A10/MF A01 CSCL 20K

Aerospace structures have to be designed with very strict reliability requirements, at the same time these structures should be as light as possible in weight to minimize the cost of launching into space. These structures are often subjected to random excitations with power spectral density varying in an arbitrary manner in the frequency domain. With the advent of the space shuttle, it is likely that these structures may have to be designed to withstand many launches, and hence fatigue will be an important factor along with other considerations while optimizing the design. An approach for handling and incorporating fatigue design constraints in optimizing aerospace structures is presented. Miner's criterion of cumulative fatigue damage was used to formulate the fatigue constraint to ensure that the total expected fatigue damage over the required period of fatigue life does not exceed unity. The fatigue constaint is used in conjunction with other probabilistic constraints such as those on displacements, stresses and on component sizes, when subjected to random vibration loads, to arrive at an optimum design. An optimum design of a typical satellite antenna structure was realized using the proposed approach.

Author

N87-21025# Harris Corp., Melbourne, Fla. Government Aerospace Systems Div.

OPUS: OPTIMAL PROJECTION FOR UNCERTAIN SYSTEMS Annual Report, 1 Oct. 1985 - 1 Oct. 1986

DENNIS S. BERNSTEIN Oct. 1986 354 p

(Contract F49620-86-C-0002)

(AD-A176820; AFOSR-87-0161TR) Avail: NTIS HC A16/MF A01 CSCL 22B

Increased interest in deploying large flexible spacecraft has focused attention on active structural control techniques to achieve crucial advances in vibration suppression, pointing accuracy and shape control. The extreme complexity of such systems and the lack of accurate finite-element structural models present severe control design challenges which were extensively accumulated by previous government research programs. OPUS is a rigorous new approach to this class of problems, which embodies a fundamental generalization of classical steady state linear quadratic Gaussian (LQG) optimal control theory. The present scope of the theory includes robust, reduced order modelling, estimation and control for continuous-time, discrete-time and sample data systems.

GRA

N87-21030# WEA, Cambridge, Mass.
WAVE-MODE COORDINATES AND SCATTERING MATRICES
FOR WAVE PROPAGATION Technical Report, 1 Sep. 1985 - 1
Oct. 1986

JAMES H. WILLIAMS, JR., RAYMOND J. NAGEM, and HUBERT K. YEUNG 1 Oct. 1986 50 p (Contract F49620-85-C-0148)

(AD-A176998; AFOSR-87-0021TR) Avail: NTIS HC A03/MF A01 CSCL 22B

Wave-mode coordinates and scattering matrices are discussed in conjunction with the dynamic and wave propagation analyses of large space structures. Simple one-dimensional examples are given to illustrate how wave-mode coordinates and scattering matrices may be used to describe dynamics and wave propagation in such structures.

N87-21206\* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

MEASUREMENT APPARATUS AND PROCEDURE FOR THE DETERMINATION OF SURFACE EMISSIVITIES Patent

HANS-JUERGEN C. BLUME, inventor (to NASA) 24 Feb. 1987 18 p Filed 3 Dec. 1985 Supersedes N86-24880 (24 - 15, p 2445)

A method and apparatus for independently determining the electromagnetic surface emissivity of a material is developed. This is particularly useful in the design of large deployable space antennas employing mesh membrane surfaces. The system is a closed one with respect to unwanted or uncorrelated radiation outside the system. The present embodiment comprises a radiometer connected to a horn antenna, a test section sealed to the horn antenna and a cryogenically cooled matched load (cryoload) exposed to the interior of the system. The material is enclosed in a convection test chamber within a test section, heated within a test chamber and allowed to radiate within the system such that a component of the radiation energy of the material is measured by the radiometer in terms of brightness temperature. The matched load serves as the stabilizing source of uncorrelated radiation within the system by radiating at a constant cryogenic temperature. The actual physical temperature of the material is also measured during the heating process. Brightness temperature over divided by physical temperature for the same time period is the emissivity of the material according to a derivation of the Raleigh-Jeans approximation for an ideal system free from all uncorrelated radiation.

Official Gazette of the U.S. Patent and Trademark Office

N87-21388# Systems Engineering Labs., Inc., Greenbelt, Md. MODELING AND CONTROL OF FLEXIBLE STRUCTURES Annual Report, Oct. 1984 - Oct. 1985

W. H. BENNETT, G. L. BLANKENSHIP, and H. G. KWATNY 16 Dec. 1986 79 p

(Contract F49620-84-C-0115)

(AD-A177106; SEI-TR-86-13; AFOSR-87-0013TR) Avail: NTIS HC A05/MF A01 CSCL 20K

This report focuses on the roles of models of flexible structures in the design and evaluation of control laws for the damping of vibrational motions in those structures. The first section discusses a generic class of continuum models for flexible structures describing the abstract mathematical formulation of the models as a framework for the design of control laws. The second section shows how direct frequency domain designs for control laws may be achieved for this class of models based on a spectral factorization procedure which replaces the usual computation of Riccati equations. The third section examines the problem of deriving transfer function representations of the structural models as required in the frequency domain design procedure. Section four describes an analytical procedure for the derivation of continuum models for large scale structures with a regular infrastucture. GRA

N87-21987\*# Martin Marietta Aerospace, Denver, Colo.
NEAR-FIELD TESTING OF THE 5-METER MODEL OF THE
TETRAHEDRAL TRUSS ANTENNA

NEILL KEFAUVER, TOM CENCICH, JIM OSBORN, and J. T. OSMANSKI Aug. 1986 167 p

(Contract NAS1-18016)

(NASA-CR-178147; NAS 1.26:178147; MCR-85-640) Avail: NTIS HC A08/MF A01 CSCL 22B

This report documents the technical results from near-field testing of the General Dynamics 5-meter model of the tetrahedral truss antenna at the Martin Marietta Denver Aerospace facility. A 5-meter square side of the tetrahedral served as the perimeter of the antenna, and a mesh surface and extensive surface contouring cord network was used to create a parabolic aperture shape to within an rms accuracy of 30 mils or better. Pattern measurements were made with offset feed systems radiating at frequencies of 7.73, 11.60, 2.27, and 4.26 (all in GHz). This report discusses the method of collecting the data, system measurement accuracy, the test data compiled, and diagostics and isolation of causes of pattern results. The technique of using near-field phase for measuring surface mechanical tolerances is included. Detailed far field antenna patterns and their implications are provided for all tests conducted.

N87-21992# WEA, Cambridge, Mass.
COMPARISON OF WAVE-MODE COORDINATE AND PULSE
SUMMATION METHODS Interim Report, 1 Sep. 1985 - 1 Dec.
1986

JAMES H. WILLIAMS, JR., RAYMOND J. NAGEM, and HUBERT K. YEUNG 1 Dec. 1986 18 p

(Contract F49620-85-C-0148)

(AD-A177795; AFOSR-87-0280TR) Avail: NTIS HC A02/MF A01 CSCL 20K

Nondispersive pulse propagation in a simple one-dimensional lattice structure is analyzed using the pulse summation method and the wave-mode coordinate method. The results of the two methods are shown to be identical, and both methods account for the existence of equivalent paths in the lattice. Some recommendations for future research are given.

N87-22252# Maryland Univ., College Park. Dept. of Aerospace

DYNAMIC FINITE ELEMENT MODELING OF FLEXIBLE STRUCTURES Final Report, 1 Sep. 1985 - 23 Feb. 1986

C. S. CHOI, E. R. CHRISTENSEN, and S. W. LEE 20 Nov. 1986 39 p

(Contract AF-AFOSR-0352-85)

(AD-A177168; AFOSR-87-0165TR) Avail: NTIS HC A03/MF A01

In Part 1, reduced basis techniques are applied to the problem of the nonlinear analysis of the dynamics of unrestrained flexible structures. The reduced bases used consisted of mode shapes of the structure as well as some modal derivatives. The technique was tested on a simple spacecraft structure. The numerical results indicated that the technique did not appear very promising for this type of problem. In Part 2, a finite element technique is used for analysis of very flexible structures undergoing deployment maneuvers. The structure is assumed to consist of flexible bars attached to a rigid mass. The description of elastic deformation is based on the total Lagrangian formulation which allows finite rotation. Numerical tests demonstrates the validity of the present approach.

N87-22256# WEA, Cambridge, Mass.
WAVE PROPAGATION IN TRANSVERSELY ISOTROPIC
CONTINUUM MODELS OF LSS (LARGE SPACE STRUCTURES)
Interim Report, 1 Sep. 1985 - 1 Jan. 1987

JAMES H. WILLIAMS, JR., RAYMOND J. NAGEM, and KARIM G.

SALAME 1 Jan. 1987 35 p (Contract F49620-85-C-0148)

(AD-A177271; AFOSR-87-0279TR) Avail: NTIS HC A03/MF A01 CSCL 20K

Continuum models of large repetitive lattice structures are often

used to provide computationally efficient analyses of static, dynamic and thermomechanical properties. In this report, a continuum model is used to study wave propagation in lattice structures. Attention is focused on a tetrahedral lattice structure which may be modeled as an equivalent homogeneous transversely isotropic continuum. Numerical results for phase velocities, deviation angles, and wave front surfaces in the equivalent continuum show that wave propagation in lattice structures may be remarkably different from the more familiar wave propagation in isotropic continua. The results given here, which ignore all effects of boundaries of the lattice and which are valid for wavelengths that are long compared with the basic cell size of the lattice, are intended to give insight into how waves may propagate in large repetitive lattice structures.

GRA

N87-22269# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Apparate.

## STRESS AND DEFORMATION ANALYSIS OF LIGHTWEIGHT COMPOSITE STRUCTURES

KARL PFEIFER and JOERG BODE Oct. 1986 17 p Presented at the 37th International Astronautical Congress, Innsbruck, Austria, 4-11 Oct. 1986 Previously announced in IAA as A87-15939 (MBB-UD-489/86; IAF-86-212; ETN-87-99930) Avail: ISSUING ACTIVITY

The influence of thermal stress and deformation on curved beams and shells, particularly for the reflector shells of spacecraft antennas, is reviewed. It is shown that the antenna contour distortions can be minimized by thermal expansion coefficients close to zero for all parts, or be a combination of vertical and horizontal displacements which deform the whole shell within the original contour.

N87-22703\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

STATUS OF THE MAST EXPERIMENT

BRANTLEY R. HANKS, ANTHONY FONTANA, and JOHN L. ALLEN In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 29-56 Apr. 1987

Avail: NTIS HC A99/MF E03 CSCL 22B

Many sophisticated mathematical control techniques for flexible structures have been devised. The basic problem is that most of them require a relatively accurate mathematical model of the system under control including the dynamics of both the structure and the control system components. Obtaining such a model for either subsystem traditionally has required great effort including a significant validation step based on test data. Because of the quantum increase in complexity over proven methods, promising techniques for the control of flexible structures must be validated in actual hardware experiments before committing to their use in actual spacecraft missions. The Mast experiment system serves as a focus for such validation. It is the first in a series of experiments under the Control of Flexible Structures (COFS) Program at the NASA Langley Research Center. The Mast experiment is a combination of ground tests, orbital flight test, and analysis of a deployable beam under the COFS program. It provides a vehicle for research in structures, structural dynamics, and control issues.

N87-22704\*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

### LARGE SPACE STRUCTURES GROUND EXPERIMENT CHECKOUT

HENRY B. WAITES In its Structural Dynamics and Control Interaction of Flexible Structures p 57-84 Apr. 1987

Avail: NTIS HC A99/MF E03 CSCL 22B

NASA Marshall Space Flight Center has developed a facility in which closed loop control of Large Space Structures (LSS) can be demonstrated and verified. The main objective of the facility is to verify LSS control system techniques so that on-orbit performance can be ensured. The facility consists of an LSS test article or payload which is connected to a 3-axis angular pointing mount assembly that provides control torque commands. The

angular pointing mount assembly is attached to a base excitation system which will simulate disturbances most likely to occur for Orbiter and DOD payloads. The control computer contains the calibration software, the reference systems, the alignment procedures, the telemetry software, and the control algorithms. The total system is suspended in such a fashion that the LSS test article has the characteristics common to all LSS.

N87-22705\*# Air Force Rocket Propulsion Lab., Edwards AFB, Calif.

### IDENTIFICATION OF LARGE SPACE STRUCTURES: A STATE-OF-PRACTICE REPORT

 In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 85-98 Apr. 1987
 Avail: NTIS HC A99/MF E03 CSCL 22B

An outline of this work is presented. It begins with a schematic flow diagram and a logical flow diagram of the identification process for large space structures (LSS). Next, the task is defined by a structure model definition. A matrix polynomial formulation with a node displacement equation and a state variable formulation with node displacement and velocities are outlined. Further outlined is the identification of LSS on orbit; modeling errors and uncertainties the identification and validation of model; and noise, computations, and data collection.

# N87-22707\*# Tennessee Univ. Space Inst., Tullahoma. A GENERAL METHOD FOR DYNAMIC ANALYSIS OF STRUCTURES OVERVIEW

REMI C. ENGELS In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 119-132 Apr. 1987

(Contract F29601-85-K-0054)

Avail: NTIS HC A99/MF E03 CSCL 20K

The presented research deals with the development of a dynamic analysis method for structural systems. The modeling approach is essentially a finite element method in the sense that the structure is divided into n elements. An element is defined as any structural unit whose degree of freedom (dofs) can be categorized as either interface or non-interface dofs. An element could be a fundamental unit such as a rod, a beam, a plate etc., or it could be an entire structural component. Furthermore, the parameters for the element could be distributed or lumped. The choice of elements is totally arbitrary and is a matter of user convenience. In particular, issues of accuracy and convergence do not enter on the level of example that bookkeeping is reduced to a minimum. Each element is modeled using a set of interface constraint modes (ICM) combined with a set of interface restrained normal models (IRNM). The next step is the solution of the system eigenvalue problem. The procedure calls for the sequential solution of a number of small eigenvalue problems based on a truncation principle for IRNM. In addition, the form of these eigenvalue problems is very simple such that an escalator type of eigenvalue problem solver can be used which is extremely cost-effective and

N87-22710\*# Engineering Mechanics Association, Inc., Torrance, Calif.

### A COMPUTER PROGRAM FOR MODEL VERIFICATION OF DYNAMIC SYSTEMS

J. D. CHROSTOWSKI and T. K. HASSELMAN In NASA, Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 199-214 Apr. 1987

Avail: NTIS HC A99/MF E03 CSCL 09B

Dynamic model verification is the process whereby an analytical model of a dynamic system is compared with experimental data, and then qualified for future use in predicting system response in a different dynamic environment. There are various ways to conduct model verification. The approach adopted in MOVER II employs Bayesian statistical parameter estimation. Unlike curve fitting whose objective is to minimize the difference between some analytical function and a given quantity of test data (or curve), Bayesian estimation attempts also to minimize the difference between the parameter values of that function (the model) and their initial

estimates, in a least squares sense. The objectives of dynamic model verification, therefore, are to produce a model which: (1) is in agreement with test data, (2) will assist in the interpretation of test data, (3) can be used to help verify a design, (4) will reliably predict performance, and (5) in the case of space structures, facilitate dynamic control.

N87-22712\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

VERIFICATION OF LARGE BEAM-TYPE SPACE STRUCTURES CHOON-FOO SHIH, JAY C. CHEN, and JOHN A. GARBA In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 247-254 Apr. 1987 Avail: NTIS HC A99/MF E03 CSCL 20K

The verification approach of large beam type space structures is verified. The proposed verification approach consists of two parts. The first part is to remove the gravity effect on the tested substructure and to identify the on-orbit dynamic characteristics of the substructure by using the measurements of the ground test. A scaling law is also established to define the critical length of the structure which can be tested in 1-g field without incurring a buckling problem. The second part is to develop an adequate scaling law to extrapolate the dynamic characteristics of the prototype structure by using results from the substructure. The verification approaches are demonstrated on two typical structural configurations, the feed support structure of a wrap-rip antenna and a candidate shuttle flight experiment. The results indicate that it is practical to verify the on-orbit dynamic characteristics of these structures by using the proposed approach. Author

N87-22713\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

### VERIFICATION OF FLEXIBLE STRUCTURES BY GROUND TEST

BEN K. WADA and C. P. KUO In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 255-274 Apr. 1987

Avail: NTIS HC A99/MF E03 CSCL 20K

The validation of math models of large space structures (LSS) by ground tests is attempted. Concepts for two types of LSS are presented: continuous type and linked subsystems. It was concluded that ground test which simulate space conditions are not entirely reliable, that there should be an integration of testing and analyses, which then should be validated with laboratory and flight experiments.

### N87-22718\*# Boeing Aerospace Co., Seattle, Wash. FLEXIBLE SPACECRAFT SIMULATOR

 In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 399-416 Apr. 1987
 Avail: NTIS HC A99/MF E03 CSCL 14B

Verification of control algorithms for flexible spacecraft can be done only through simulation and test; these are necessary to understand control/structure interaction (C/SI) sufficiently to design robust controllers for future spacecraft. The objective persued is to develop a low-cost facility which simulates the fundamental problem of C/SI; and to provide accessibility for designs so that experience can be gained in applying various multivariable control design methods to an actual structure. A test facility is being constructed with test elements that provide 3 rigid body and 6 flexible modes, all in the horizontal plane, with frequencies below 2.5 Hz. The control force actuator are on/off air jets with sensing by optical displacement sensors. Loop closure is provided by a digital computer with control algorithms designed using the IAC and MATRIX-X.

N87-22719\*# Auburn Univ., Ala. Dept. of Electrical Engineering.
IMPROVING STABILITY MARGINS IN DISCRETE-TIME LQG CONTROLLERS

B. TARIK ORANC and CHARLES L. PHILLIPS In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction

of Flexible Structures p 417-434 Apr. 1987 Avail: NTIS HC A99/MF E03 CSCL 12A

Some of the problems are discussed which are encountered in the design of discrete-time stochastic controllers for problems that may adequately be described by the Linear Quadratic Gaussian (LQG) assumptions; namely, the problems of obtaining acceptable relative stability, robustness, and disturbance rejection properties. A dynamic compensator is proposed to replace the optimal full state feedback regulator gains at steady state, provided that all states are measurable. The compensator increases the stability margins at the plant input, which may possibly be inadequate in practical applications. Though the optimal regulator has desirable properties the observer based controller as implemented with a Kalman filter, in a noisy environment, has inadequate stability margins. The proposed compensator is designed to match the return difference matrix at the plant input to that of the optimal regulator while maintaining the optimality of the state estimates as directed by the measurement noise characteristics.

# N87-22724\*# Boeing Aerospace Co., Seattle, Wash. DYNAMICS OF TRUSSES HAVING NONLINEAR JOINTS

J. M. CHAPMAN, F. H. SHAW, and W. C. RUSSELL In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 539-566 Apr. 1987 Avail: NTIS HC A99/MF E03 CSCL 20K

The transient analysis of trusses having nonlinear joints can be accomplished using the residual force technique. The technique was applied a two degree of freedom spring mass system, a four bay planar truss, and an actual ten bay deployable truss. Joints chosen for analysis were the nonlinear gap joints and the linear Voigt joints. Results from the nonlinear gap analyses generally indicate that coupling between the modes can display some interesting effects during free vibration. One particularly interesting effect was that the damping of the structure appeared to be higher than could be accounted for from modal damping alone. Energy transferral from the lower to the higher modes was found to exist as a result of the modal coupling. The apparently increased damping was due to the fact that the energy transferred to the higher modes is inherently dissipated more quickly. Another interesting phenomenon was that the lower modes could drive the higher modes even during free vibration and that these modes could display a rather large quasi-steady state behavior even when modal damping was present. Gaps were also found to increase the amplitude and period of the free vibration response as Author expected.

# N87-22725\*# Boeing Aerospace Co., Seattle, Wash. EQUIVALENT BEAM MODELING USING NUMERICAL REDUCTION TECHNIQUES

J. M. CHAPMAN and F. H. SHAW *In* NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 567-594 Apr. 1987
Avail: NTIS HC A99/MF E03 CSCL 20K

Numerical procedures that can accomplish model reductions for space trusses were developed. Three techniques are presented that can be implemented using current capabilities within NASTRAN. The proposed techniques accomplish their model reductions numerically through use of NASTRAN structural analyses and as such are termed numerical in contrast to the previously developed analytical techniques. Numerical procedures are developed that permit reductions of large truss models containing full modeling detail of the truss and its joints. Three techniques are presented that accomplish these model reductions with various levels of structural accuracy. These numerical techniques are designated as equivalent beam, truss element reduction, and post-assembly reduction methods. These techniques are discussed in detail.

N87-22726\*# National Aeronautics and Space Administration.
Marshall Space Flight Center, Huntsville, Ala.
DYNAMIC CHARACTERISTICS OF A VIBRATING BEAM WITH
PERIODIC VARIATION IN BENDING STIFFNESS

JOHN S. TOWNSEND In its Structural Dynamics and Control Interaction of Flexible Structures p 595-624 Apr. 1987

Avail: NTIS HC A99/MF E03 CSCL 20K

A detailed dynamic analysis is performed of a vibrating beam with bending stiffness periodic in the spatial coordinate. Using a perturbation expansion technique the free vibration solution is obtained in a closed-form, and the effects of system parameters on beam response are explored. It is found that periodic stiffness acts to modulate the modal displacements from the characteristic shape of a simple sine wave. The results are verified by a finite element solution and through experimental testing.

N87-22727\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

#### STRUCTURAL DYNAMICS SYSTEM MODEL REDUCTION

J. C. CHEN, T. L. ROSE, and B. K. WADA In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 625-668 Apr. 1987 Avail: NTIS HC A99/MF E03 CSCL 20K

Loads analysis for structural dynamic systems is usually performed by finite element models. Because of the complexity of the structural system, the model contains large number of degree-of-freedom. The large model is necessary since details of the stress, loads and responses due to mission environments are computed. However, a simplified model is needed for other tasks such as pre-test analysis for modal testing, and control-structural interaction studies. A systematic method of model reduction for modal test analysis is presented. Perhaps it will be of some help in developing a simplified model for the control studies. Author

N87-22728\*# National Aeronautics and Space Administration.
Marshall Space Flight Center, Huntsville, Ala.
WORKSHOP ON STRUCTURAL DYNAMICS AND CONTROL

INTERACTION OF FLEXIBLE STRUCTURES
L. P. DAVIS, J. F. WILSON (Sperry Corp., Phoenix, Ariz.), and R.
E. JEWELL *In its* Structural Dynamics and Control Interaction of
Flexible Structures p 669-690 Apr. 1987 Reprinted from
Vibration Damping Workshop, 6 Mar. 1986
Avail: NTIS HC A99/MF E03 CSCL 20K

The Hubble Space Telescope features the most exacting line of sight litter requirement thus far imposed on a spacecraft pointing system. Consideration of the fine pointing requirements prompted an attempt to isolate the telescope from the low level vibration disturbances generated by the attitude control system reaction wheels. The primary goal was to provide isolation from axial component of wheel disturbance without compromising the control system bandwidth. A passive isolation system employing metal springs in parallel with viscous fluid dampers was designed, fabricated, and space qualified. Stiffness and characteristics are deterministic, controlled independently, and were demonstrated to remain constant over at least five orders of input disturbance magnitude. The damping remained purely viscous even at the data collection threshold of .16 x .000001 in input displacement, a level much lower than the anticipated Hubble Space Telescope disturbance amplitude. Vibration attenuation goals were obtained and ground test of the vehicle has demonstrated the isolators are transparent to the attitude control system.

N87-22733\*# General Electric Co., Philadelphia, Pa. Spac

IMPACT OF SPACE STATION APPENDAGE VIBRATIONS ON THE POINTING PERFORMANCE OF GIMBALLED PAYLOADS ROBERT O. HUGHES In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures

841-866 Apr. 1987

Avail: NTIS HC A99/MF E03 CSCL 22B

A study of the interface problems between the Space Station Structure (vibrations) and the Payload Pointing Control System was undertaken. A major goal of the study was to identify any bounding factors that might limit the achievement of required pointing accuracies. A major result is that the space station will have a disturbance-rich environment and the background levels

will be large enough to impact the pointing of some of the payloads. The need for an interface vibration specification between the structure and the payloads was identified.

Author

# N87-22738\*# Boeing Aerospace Co., Seattle, Wash. HIGH SPEED SIMULATION OF FLEXIBLE MULTIBODY DYNAMICS

A. D. JACOT, R. E. JONES, and C. D. JUENGST In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 979-998 Apr. 1987

Avail: NTIS HC A99/MF E03 CSCL 09B

A multiflexible body dynamics code intended for fast turnaround control design trades is described. Nonlinear rigid body dynamics and linearized flexible dynamics combine to provide efficient solution of the equations of motion. Comparison with results from the DISCOS code provide verification of accuracy.

Author

# N87-22739\*# Texas Univ., Austin. Dept. of ASE-EM. LANCZOS MODES FOR REDUCED-ORDER CONTROL OF FLEXIBLE STRUCTURES

ROY R. CRAIG, JR. and RUSSELL M. TURNER In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 999-1012 Apr. 1987 Avail: NTIS HC A99/MF E03 CSCL 22B

Lanczos mode models represent low-frequency forced response better than do normal mode models and can be developed for both continuous and finite element structural representations. It was recommended that Lanczos mode models for systems with multiple input and/or rigid body modes should be developed; numerical stability of the Lanczos algorithm should be assessed; and control system designs employing the Lanczos mode models should be attempted.

**N87-22743\***# Auburn Univ., Ala. Dept. of Aerospace Engineering.

# A NEW APPROACH FOR VIBRATION CONTROL IN LARGE SPACE STRUCTURES

K. KUMAR and J. E. COCHRAN, JR. In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 1079-1094 Apr. 1987

Avail: NTIS HC A99/MF E03 CSCL 20K

An approach for augmenting vibration damping characteristics in space structures with large panels is presented. It is based on generation of bending moments rather than forces. The moments are generated using bimetallic strips, suitably mounted at selected stations on both sides of the large panels, under the influence of differential solar heating, giving rise to thermal gradients and stresses. The collocated angular velocity sensors are utilized in conjunction with mini-servos to regulate the control moments by flipping the bimetallic strips. A simple computation of the rate of dissipation of vibrational energy is undertaken to assess the effectiveness of the proposed approach.

N87-22745\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

# MODELING OF CONTROLLED FLEXIBLE STRUCTURES WITH IMPULSIVE LOADS

M. ZAK In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 1161-1178 Apr. 1987

Avail: NTIS HC A99/MF E03 CSCL 22B

The characteristic wave approach is developed as an alternative to modal methods which may lead to significant errors in the presence of impulsive or concentrated loads. The method is applied to periodic structures. Some special phenomena like cumulation effects and transitions to ergodicity are analyzed.

Author

N87-22747\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

### ON THE CONTROL OF STRUCTURES BY APPLIED THERMAL GRADIENTS

DON EDBERG and JAY-C. CHEN In NASA. Marshall Space

Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 1214-1250 Apr. 1987

Avail: NTIS HC A99/MF E03 CSCL 20K

Some preliminary results of research on control of flexible structures performed at the Jet Propulsion Laboratory are presented. It was shown that the thermoelectric device is a feasible actuator and may effectively be used to control structures, provided the structure has a relatively low thermal inertia. The control law only depends on the open-loop system natural frequency.

B.G.

# N87-22749\*# Boeing Aerospace Co., Seattle, Wash. EXPERIMENTAL CHARACTERIZATION OF DEPLOYABLE TRUSSES AND JOINTS

R. IKEGAMI, S. M. CHURCH, D. A. KEINHOLZ, and B. L. FOWLER (CSA Engineering, Inc., Palo Alto, Calif.) //n NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 1271-1288 Apr. 1987

Avail: NTIS HC A99/MF E03 CSCL 20K

The structural dynamic properties of trusses are strongly affected by the characteristics of joints connecting the individual beam elements. Joints are particularly significant in that they are often the source of nonlinearities and energy dissipation. While the joints themselves may be physically simple, direct measurement is often necessary to obtain a mathematical description suitable for inclusion in a system model. Force state mapping is a flexible, practical test method for obtaining such a description, particularly when significant nonlinear effects are present. It involves measurement of the relationship, nonlinear or linear, between force transmitted through a joint and the relative displacement and velocity across it. An apparatus and procedure for force state mapping are described. Results are presented from tests of joints used in a lightweight, composite, deployable truss built by the Boeing Aerospace Company. The results from the joint tests are used to develop a model of a full 4-bay truss segment. The truss segment was statically and dynamically tested. The results of the truss tests are presented and compared with the analytical predictions from the model.

N87-22750\*# National Aeronautics and Space Administration.
Marshall Space Flight Center, Huntsville, Ala.
SYSTEM IDENTIFICATION FOR LARGE SPACE STRUCTURE

### SYSTEM IDENTIFICATION FOR LARGE SPACE STRUCTURE DAMAGE ASSESSMENT

J. C. CHEN and J. A. GARBA In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 1289-1318 Apr. 1987 Avail: NTIS HC A99/MF E03 CSCL 22B

The need for monitoring the dynamic characteristics of large structural systems for purposes of assessing the potential degradation of structural properties was established. A theory for assessing the occurrence, location, and extent of potential damage was developed utilizing on-orbit response measurements. Feasibility of the method is demonstrated using a simple structural system as an example.

N87-22751\*# National Aeronautics and Space Administration.

Marshall Space Flight Center, Huntsville, Ala.

SPACE STATION STRUCTURES AND DYNAMICS TEST

PROGRAM

FRANK M. BUGG, E. W. IVEY, C. J. MOORE, and JOHN S. TOWNSEND In its Structural Dynamics and Control Interaction of Flexible Structures p 1319-1332 Apr. 1987
Avail: NTIS HC A99/MF E03 CSCL 22B

The design, construction, and operation of a low-Earth orbit space station poses challenges for development and implementation of technology. One specific challenge is the development of a dynamics test program for defining the space station design requirements, and identifying and characterizing phenomena affecting the space station's design and development. The test proposal, as outlined, is a comprehensive structural dynamics program to be launched in support of the space station (SS). Development of a parametric data base and verification of the mathematical models and analytical analysis tools necessary for engineering support of the station's design, construction, and

operation provide the impetus for the dynamics test program. The four test phases planned are discussed: testing of SS applicable structural concepts; testing of SS prototypes; testing of actual SS structural hardware; and on-orbit testing of SS construction. B.G.

N87-23683# California Univ., Berkeley. Electronics Research Lab.

AN INTEGRATED, OPTIMIZATION-BASED APPROACH TO THE DESIGN AND CONTROL OF LARGE SPACE STRUCTURES Final Technical Report, 1 Oct. 1983 - 30 Sep. 1986

ELIJAH POLAK, KARL S. PISTER, and ROBERT L. TAYLOR 30

Sep. 1986 10 p (Contract AF-AFOSR-0361-83)

(AD-A179459; AFOSR-87-0402TR) Avail: NTIS HC A02/MF A01 CSCL 20K

This research was aimed at laying the groundwork for a long term project on the integrated, optimization-based design of large, flexible structures and their control systems. Research was carried out in four areas: (1) modeling the dynamic behavior of simple flexible structures; (2) development of a theory of nondifferentiable optimization algorithms for the solution of problems with max function type inequality constraints; (3) exploration of the use of optimization in optimization-based design of large, flexible structures and their control systems; and (4) interactive software for optimization-based control system design.

N87-23980\*# Catholic Univ. of America, Washington, D.C. Dept. of Mechanical Engineerining.

MODIFIED INDEPENDENT MODAL SPACE CONTROL METHOD FOR ACTIVE CONTROL OF FLEXIBLE SYSTEMS

A. BAZ and S. POH Jul. 1987 32 p (Contract NAG5-520; NAG5-749)

(NASA-CR-181065; NAS 1.26:181065) Avail: NTIS HC A03/MF A01 CSCL 13I

A modified independent modal space control (MIMSC) method is developed for designing active vibration control systems for large flexible structures. The method accounts for the interaction between the controlled and residual modes. It incorporates also optimal placement procedures for selecting the optimal locations of the actuators in the structure in order to minimize the structural vibrations as well as the actuation energy. The MIMSC method relies on an important feature which is based on time sharing of a small number of actuators, in the modal space, to control effectively a large number of modes. Numerical examples are presented to illustrate the application of the method to generic flexible systems. The results obtained suggest the potential of the devised method in designing efficient active control systems for large flexible structures.

N87-24495\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

NAŠA/DOD CONTROL/STRUCTURES INTERACTION TECHNOLOGY, 1986

ROBERT L. WRIGHT, comp. Jun. 1987 314 p Conference held in Norfolk, Va., 18-21 Nov. 1986

Papers presented at the CSI Technology Conference are given. The conference was jointly sponsored by the NASA Office of Aeronautics and Space Technology and the Department of Defense. The conference is the beginning of a series of annual conferences whose purpose is to report to industry, academia, and government agencies the current status of Control/Structures Interaction technology. The conference program was divided into five sessions: (1) Future spacecraft requirements; Technology issues and impact; (2) DOD special topics; (3) Large space systems technology; (4) Control of flexible structures, and (5) Selected NASA research in control structures interaction.

N87-24497\*# Air Force Weapons Lab., Kirtland AFB, N. Mex. JOINT OPTICS STRUCTURES EXPERIMENT (JOSE)
DAVID FOUNDS /n NASA-Langley Research Center NASA/DOD

Control/Structures Interaction Technology, 1986 p 591-602 Jul 1987

Avail: NTIS HC A14/MF A01 CSCL 20F

The objectives of the JOSE program is to develop, demonstrate, and evaluate active vibration suppression techniques for Directed Energy Weapons (DEW). DEW system performance is highly influenced by the line-of-sight (LOS) stability and in some cases by the wave front quality. The missions envisioned for DEW systems by the Strategic Defense Initiative require LOS stability and wave front quality to be significantly improved over any current demonstrated capability. The Active Control of Space Structures (ACOSS) program led to the development of a number of promising structural control techniques. DEW structures are vastly more complex than any structures controlled to date. They will be subject to disturbances with significantly higher magnitudes and wider bandwidths, while holding higher tolerances on allowable motions and deformations. Meeting the performance requirements of the JOSE program requires upgrading the ACOSS techniques to meet new more stringent requirements, the development of requisite sensors and acturators, improved control processors, highly accurate system identification methods, and the integration of hardware and methodologies into a successful demonstration.

Author

N87-24501\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

DESIGN, CONSTRUCTION, AND UTILIZATION OF A SPACE STATION ASSEMBLED FROM 5-METER ERECTABLE STRUTS MARTIN M. MIKULAS, JR. and HAROLD G. BUSH In its NASA/DOD Control/Structures Interaction Technology, 1986 p 675-699 Jun. 1987

Avail: NTIS HC A14/MF A01 CSCL 22B

The primary characteristics of the 5-meter erectable truss is presented, which was baselined for the Space Station. The relatively large 5-meter truss dimension was chosen to provide a deep beam for high bending stiffness yet provide convenient mounting locations for space shuttle cargo bay size payloads which are approx. 14.5 ft (4.4 m) in diameter. Truss nodes and quick attachment erectable joints are described which provide for evolutionary three dimensional growth and for simple maintenance and repair. A mobile remote manipulator system is described which is provided to assist in station construction and maintenance. A discussion is also presented of the construction of the Space Station and the associated extravehicular active (EVA) time.

Author

N87-24505\*# TRW Space Technology Labs., Redondo Beach, Calif.

# APPLICATION OF PHYSICAL PARAMETER IDENTIFICATION TO FINITE-ELEMENT MODELS

ALLEN J. BRONOWICKI, MICHAEL S. LUKICH, and STEVEN P. KURITZ In NASA-Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 p 747-755 Jun. 1987

Avail: NTIS HC A14/MF A01 CSCL 22B

The time domain parameter identification method described previously is applied to TRW's Large Space Structure Truss Experiment. Only control sensors and actuators are employed in the test procedure. The fit of the linear structural model to the test data is improved by more than an order of magnitude using a physically reasonable parameter set. The electro-magnetic control actuators are found to contribute significant damping due to a combination of eddy current and back electro-motive force (EMF) effects. Uncertainties in both estimated physical parameters and modal behavior variables are given.

N87-24510\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

#### **GROUND TEST OF LARGE FLEXIBLE STRUCTURES**

BEN K. WADA In NASA-Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 p 831-850 Jun. 1987

Avail: NTIS HC A14/MF A01 CSCL 22B

Many future mission models require large space (LSS) which have accurate surfaces and/or the capability of being accurately aligned. If ground test approaches which will provide adequate confidence of the structrual performance to the program managers are not developed, many viable structural concepts may never be utilized. The size and flexibility of many of the structural concepts will preclude the use of the current ground test methods because of the adverse effects of the terrestrial environment. The challenge is to develop new test approaches which will provide confidence in the capability of LSS to meet performance requirements prior to flight. The activities on ground testing of LSS are described. Since some of the proposed structural systems cannot be tested in entirety, a coordinated ground test analytical model program is required to predict structural performance in space. Several concepts of ground testing under development are addressed.

Author

N87-24516# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

# INVESTIGATION FOR DAMPING DESIGN AND RELATED NONLINEAR VIBRATIONS OF SPACECRAFT STRUCTURES Final Report

E. HILBRANDT, I. KOLSCH, and W. CHARON Paris, France ESA Dec. 1985 438 p

(Contract ESTEC-5326/83-NL-PB(SC))

(EMSB-64/85; ESA-CR(P)-2329; ETN-87-99881) Avail: NTIS HC A19/MF A01

The sources of damping in spacecraft structures and substructures, their representation, analytical methods, and test procedures are investigated. Design concepts are developed and are verified on hardware applications. The description of the single damping sources is one of the main problems for the damping prediction method for substructures. The efficiency of the different damping sources differs by orders of magnitude. Damping prediction of substructures by the loss factor analysis method is sensitive to damping source characterization. The damping prediction of the substructures program developed, is written as a data base oriented batch program. A finite element calculation delivers all modal data for the total description of the structure including eigenvalues, eigenmodes, modal stresses, modal strains, and energies on element level.

N87-24517# Systems Engineering Labs., Inc., Greenbelt, Md. SPECTRAL FACTORIZATION AND HOMOGENIZATION METHODS FOR MODELING AND CONTROL OF FLEXIBLE STRUCTURES Final Report, Sep. 1984 - Sep. 1986

WILLIAM H. BENNETT, G. L. BLANKENSHIP, and H. G. KWATNY 15 Dec. 1986 188 p (Contract F49620-84-C-0115)

(AD-A179726; SEI-TR-86-14; AFOSR-87-0502TR) Avail: NTIS HC A09/MF A01 CSCL 22B

This report describes continuum modeling and vibration control of flexible structures with application to active control of vibrations in large space structures. A comprehensive methodology is discussed for the construction of effective (linear) models for large composite structures consisting of various flexible members(e.g. beams, trusses, etc.) and rigid body elements. It is convenient to concentrate on frequency domain modeling. A systematic procedure is shown for computing the irrational transfer functions. Then by standard transform methods a complete hybrid model is developed. The methods were coded in a computer algebra system (SMP was used) which automated the model building process and produced Fortran code for numerical evaluation of the frequency responses. Effective continuum models of lattice structures with regular infrastructure can be obtained by a systematic procedure based on an asymptotic analysis of multiple scales called homogenization. This method is applied to several examples and accurate computation made of the required parameters of such continuum models somewhat more subtle than merely averaging over lattice cells. For the computation of distributed parameter control an optimal frequency domain method is based on solving an associated Wiener Hopf problem. The method employs effective numerical algorithms (e.g. FFT, etc.) to

compute a certain spectral factorization of a possibly matrix valued (in the multiple control case) Hermittian, positive definite transform by sampling the frequency response. The control laws take the form of distributed state feedback with respect to a naturally defined, distributed state-space of functions over the spatial domain of the structure.

N87-24520\*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

LARGE SPACE STRUCTURES TESTING

HENRY WAITES and H. EUGENE WORLEY Jun. 1987 22 p (NASA-TM-100306; NAS 1.15:100306) Avail: NTIS HC A02/MF A01 CSCL 22B

There is considerable interest in the development of testing concepts and facilities that accurately simulate the pathologies believed to exist in future spacecraft. Both the Government and Industry have participated in the development of facilities over the past several years. The progress and problems associated with the development of the Large Space Structure Test Facility at the Marshall Flight Center are presented. This facility was in existence for a number of years and its utilization has run the gamut from total in-house involvement, third party contractor testing, to the mutual participation of other Government Agencies in joint endeavors.

N87-25349\*# Astro Aerospace Corp., Carpinteria, Calif.
DESIGN, DEVELOPMENT AND FABRICATION OF A
DEPLOYABLE/RETRACTABLE TRUSS BEAM MODEL FOR
LARGE SPACE STRUCTURES APPLICATION Final Report
LOUIS R. ADAMS Jun. 1987 64 p

(Contract NAS1-18013)

(NASA-CR-178287; NAS 1.26:178287; AAC-TN-1150-REV-A)

Avail: NTIS HC A04/MF A01 CSCL 22B

The design requirements for a truss beam model are reviewed. The concept behind the beam is described. Pertinent analysis and studies concerning beam definition, deployment loading, joint compliance, etc. are given. Design, fabrication and assembly procedures are discussed.

Author

N87-25357# British Columbia Univ., Vancouver. Dept. of Mechanical Engineering.

#### A FORMULATION FOR STUDYING STEADY STATE/TRANSIENT DYNAMICS OF A LARGE CLASS OF SPACECRAFT AND ITS APPLICATION

A. M. IBRAHIM and V. J. MODI In ESA Proceedings of the Second International Symposium on Spacecraft Flight Dynamics p 25-30 Dec. 1986

(Contract NSERC-G-1547) Avail: NTIS HC A22/MF A01

A formulation for studying dynamics of a system, consisting of n connected flexible deployable members forming a topological tree or a closed configuration, is presented. The mathematical description of the system can be a combination of discrete and distributed coordinates. Joints, elastic and dissipative, permit relative rotation and translation between bodies. The elastic deformations can be discretized using admissible functions, finite elements, or lumped mass method. Rotations of the members, as well as of the entire system, can be described using a set of orientation angles, Euler parameters or Rodrigues vectors. The formulation accounts for: the presence of momentum or reaction wheels; thrusters distributed over the flexible and rigid portions; and any prescribed forms of energy dissipation mechanisms. The formulation is valid for orbiting as well as ground based and marine systems. Application of the formulation is illustrated through an example in spacecraft dynamics. **ESA** 

N87-25359# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

### THE EFFECTS OF STRUCTURAL PERTURBATIONS ON DECOUPLED CONTROL

R. A. CALICO and R. L. HINRICHSEN In ESA Proceedings of the Second International Symposium on Spacecraft Flight Dynamics

p 39-45 Dec. 1986 Avail: NTIS HC A22/MF A01

The effects of structural perturbations on the decoupled control of a large space structure are considered. The structure is controlled through multiple subcontrollers, each of which controls a subset of the spacecraft modes. The stability of the entire system is assured by constraining the gain matrices for the individual subcontrollers such that the stability of the system is not affected by the coupling between the subcontrollers. Structural perturbations reintroduce coupling among the subcontrollers, which may lead to instability. This coupling is shown to be related to changes in the row and column spaces of the individual control and observation matrices, respectively. A simple test for the determination of the effects of these changes is presented. The use of the test is evaluated on the control of the CSDL I spacecraft using three subcontrollers.

National Aeronautics and Space Administration. N87-25492\* Langley Research Center, Hampton, Va.

**DEPLOYABLE GEODESIC TRUSS STRUCTURE Patent** 

MARTIN M. MIKULAS, JR., inventor (to NASA), MARVIN D. RHODES, inventor (to NASA), and J. WAYNE SIMONTON, inventor (to NASA) 7 Jul. 1987 9 p Filed 20 Feb. 1986 Supersedes N86-24867 (24 - 15, p 2443)

(NASA-CASÈ-LAR-13113-1; US-PATENT-4,677,803; US-PATENT-APPL-SN-831371; US-PATENT-CLASS-52-646; US-PATENT-CLASS-52-108; US-PATENT-CLASS-52-632:

US-PATENT-CLASS-182-152) Avail: US Patent and Trademark Office CSCL 13I

A deployable geodesic truss structure which can be deployed from a stowed state to an erected state is described. The truss structure includes a series of bays, each bay having sets of battens connected by longitudinal cross members which give the bay its axial and torsional stiffness. The cross members are hinged at their mid point by a joint so that the cross members are foldable for deployment or collapsing. The bays are deployed and stabilized by actuator means connected between the mid point joints of the cross members. Hinged longerons may be provided to also connect the sets of battens and to collapse for stowing with the rest of the truss structure.

Official Gazette of the U.S. Patent and Trademark Office

National Aeronautics and Space Administration. N87-25576\*# Lyndon B. Johnson Space Center, Houston, Tex. COLLECT LOCK JOINT FOR SPACE STATION TRUSS Patent

CLARENCE J. WESSELSKI, inventor (to NASA) 1 Apr. 1987

(NASA-CASE-MSC-21207-1; US-PATENT-APPL-SN-032818)

Avail: NTIS HC A02/MF A01 CSCL 13K

A lock joint for a space station has a plurality of struts joined together in a predetermined configuration by node point fittings. The fittings have removable inserts therein. The lock joint has an elongated housing connected at one end to a strut. A split-fingered collet is mounted within the housing for movement reciprocally therein. A handle on the housing is connected to the collet for moving the collet into the insert where the fingers of the collet expand to lock the joint to the fitting.

N87-25605\*# Catholic Univ. of America, Washington, D.C. Dept. of Mechanical Engineering.

A COMPARISON BETWEEN IMSC, PI AND MIMSC METHODS IN CONTROLLING THE VIBRATION OF FLEXIBLE SYSTEMS

A. BAZ and S. POH Aug. 1987 31 p (Contract NAG5-520; NAG5-749)

(NASA-CR-181156; NAS 1.26:181156) Avail: NTIS HC A03/MF A01 CSCL 20K

A comparative study is presented between three active control algorithms which have proven to be successful in controlling the vibrations of large flexible systems. These algorithms are: the Independent Modal Space Control (IMSC), the Pseudo-inverse (PI), and the Modified Independent Modal Space Control (MIMSC).

Emphasis is placed on demonstrating the effectiveness of the

MIMSC method in controlling the vibration of large systems with small number of actuators by using an efficient time sharing strategy. Such a strategy favors the MIMSC over the IMSC method. which requires a large number of actuators to control equal number of modes, and also over the PI method which attempts to control large number of modes with smaller number of actuators through the use of an in-exact statistical realization of a modal controller. Numerical examples are presented to illustrate the main features of the three algorithms and the merits of the MIMSC method.

Lockheed Missiles and Space Co., Sunnyvale, N87-25606\*# Calif.

PRELIMINARY DESIGN, ANALYSIS, AND COSTING OF A DYNAMIC SCALE MODEL OF THE NASA SPACE STATION **Final Report** 

M. J. GRONET, E. D. PINSON, H. L. VOQUI, E. F. CRAWLEY, and M. R. EVERMAN (AEC-ABLE Engineering Co., Inc., Goleta, Calif.) Washington NASA Jul. 1987 208 p (Contract NAS1-18229)

(NASA-CR-4068; NAS 1.26:4068; LMSC-F177633) Avail: NTIS HC A10/MF A01 CSCL 20K

The difficulty of testing the next generation of large flexible space structures on the ground places an emphasis on other means for validating predicted on-orbit dynamic behavior. Scale model technology represents one way of verifying analytical predictions with ground test data. This study investigates the preliminary design, scaling and cost trades for a Space Station dynamic scale model. The scaling of nonlinear joint behavior is studied from theoretical and practical points of view. Suspension system interaction trades are conducted for the ISS Dual Keel Configuration and Build-Up Stages suspended in the proposed NASA/LaRC Large Spacecraft Laboratory. Key issues addressed are scaling laws, replication vs. simulation of components, manufacturing, suspension interactions, joint behavior, damping, articulation capability, and cost. These issues are the subject of parametric trades versus the scale model factor. The results of these detailed analyses are used to recommend scale factors for four different scale model options, each with varying degrees of replication. Potential problems in constructing and testing the scale model are identified, and recommendations for further study are outlined.

#### N87-26071\*# Carnegie-Mellon Univ., Pittsburgh, Pa. RESPONSE OF JOINT DOMINATED SPACE STRUCTURES Semiannual Report

May 1987 73 p (Contract NAG1-612)

(NASA-CR-180564; NAS 1.26:180564) Avail: NTIS HC A04/MF

An approximate method is developed for estimating the transient response of nonlinear systems in terms of linearized modes of response. Its advantages are that it is computationally more efficient than the time integration method and that it is possible to view the design problem in the more traditional physical terms of modal response. The major drawback of the approximate method is loss of accuracy. It seems that both approximate methods and time integration have their roles in design. Approximate methods provide efficient tools for performing parametric studies and they supply physical insights into how to optimize system performance that are not easily inferred from strictly numerical methods. Time integration provides a method for assessing the accuracy of the approximate solution for key simulations and for fine tuning the final design. In the procedure presented the nonlinear system is approximated by an equivalent linear system in which the system parameters are constant over the range of transient response.

Author

Erno Raumfahrttechnik G.m.b.H., Bremen (West N87-26075# Germany).

DEVELOPMENT OF EXPERIMENTAL/ANALYTICAL CONCEPTS FOR STRUCTURAL DESIGN VERIFICATION Final Report

E. HORNUNG, K. ECKHARDT, E. ERBEN, E. HUENERS, N. NIEDBAL, H. OERY, and H. GLASER Paris, France ESA Feb. 1985 139 p

(Contract ESTEC-5166/82-NL-PB(SC))

(ESA-CR(P)-2340; ETN-87-99991) Avail: NTIS HC A06/MF A01 Spacecraft structure analytical and test verification methods were reviewed. It is concluded that in general adequate verification capabilities exist to provide the required level of confidence in spacecraft projects. When optimal verification procedures are performed in a project low safety margins might be sufficient for the realization of the project. However, the employment of minimum safety margins, i.e., margins as requested by the launcher authorities, is not encountered in practice in the space industry because of user uncertainty as to launcher loads. To improve spacecraft design and verification activities better knowledge is required for launcher loads as they arise in reality. The recording of flight responses and loads during launch is essential for an overall improvement of design and verification activities. Such activities allow the employment of representative safety margins, and eliminate excessive margins currently employed to cover load uncertainties.

N87-26085\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

### EXPERIMENTAL EVALUATION OF SMALL-SCALE ERECTABLE TRUSS HARDWARE

DAVID M. MCGOWAN and MARK S. LAKE Jun. 1987 15 p (NASA-TM-89068; NAS 1.15:89068) Avail: NTIS HC A02/MF A01 CSCL 22B

To aid in the prediction of the dynamic behavior of the space station, a one-tenth scale dynamic test model is to be constructed of commercially available, small scale truss hardware. Tests have been performed to determine the axial stiffness characteristics and failure loads of the truss joint. A parametric study has shown that the stiffness of the joint increases as the attachment bolt torque value is increased. Furthermore, at torque values equal to or higher than 250 in-lbs, hysteresis in the load-deflection curve is essentially eliminated. Also, the joint stiffness remained relatively constant between specimens. The effective stiffness of a joint subassembly tested is 76 percent that of the strut. Tensile and compressive failure occurred in the region of the bonded plug, with lower failure loads corresponding to compressive loadings.

Author

N87-26365\*# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronatuics and Astronautics.

JOINT NONLINEARITY EFFECTS IN THE DESIGN OF A FLEXIBLE TRUSS STRUCTURE CONTROL SYSTEM MATHIEU MERCADAL Dec. 1986 164 p

(Contract NAG1-126)

(NASA-CR-180633; NAS 1.26:180633; SSL-22-86) Avail: NTIS HC A08/MF A01 CSCL 20K

Nonlinear effects are introduced in the dynamics of large space truss structures by the connecting joints which are designed with rather important tolerances to facilitate the assembly of the structures in space. The purpose was to develop means to investigate the nonlinear dynamics of the structures, particularly the limit cycles that might occur when active control is applied to the structures. An analytical method was sought and derived to predict the occurrence of limit cycles and to determine their stability. This method is mainly based on the quasi-linearization of every joint using describing functions. This approach was proven successful when simple dynamical systems were tested. Its applicability to larger systems depends on the amount of computations it requires, and estimates of the computational task tend to indicate that the number of individual sources of nonlinearity should be limited. Alternate analytical approaches, which do not account for every single nonlinearity, or the simulation of a simplified model of the dynamical system should, therefore, be investigated to determine a more effective way to predict limit cycles in large dynamical systems with an important number of distributed nonlinearities.

N87-26370\*# Iowa Univ., Iowa City. Dept. of Mechanical Engineering.
SHAPE DESIGN SENSITIVITY ANALYSIS AND OPTIMAL DESIGN OF STRUCTURAL SYSTEMS
KYUNG K. CHOI 1987 54 p
(Contract NAG1-215)
(NASA-CR-181095; NAS 1.26:181095) Avail: NTIS HC A04/MF A01 CSCL 20K

The material derivative concept of continuum mechanics and an adjoint variable method of design sensitivity analysis are used to relate variations in structural shape to measures of structural performance. A domain method of shape design sensitivity analysis is used to best utilize the basic character of the finite element method that gives accurate information not on the boundary but in the domain. Implementation of shape design sensitivity analysis using finite element computer codes is discussed. Recent numerical results are used to demonstrate the accuracy obtainable using the method. Result of design sensitivity analysis is used to carry out design optimization of a built-up structure.

Author

# N87-26387 Georgia Inst. of Tech., Atlanta. VIBRATION CONTROL OF FLEXIBLE STRUCTURES USING PIEZOELECTRIC DEVICES AS SENSORS AND ACTUATORS Ph.D. Thesis

MICHAEL WALTER OBAL 1986 266 p Avail: Univ. Microfilms Order No. DA8707860

The problem of the active control of linear elastic structures using piezoceramic transducers as sensors and actuators was investigated by a combined theoretical and experimental approach. The optimal rate feedback gain distribution of an active structure with multiple collocated sensors and actuators was obtained by using a limited state feedback approach which resulted in an increase in system damping. To model the active structure for the optimal control problem, a finite element model was developed. An active element consisting of a simple beam element with a bonded unimorphic piezoceramic sensors and actuators was obtained. The model incorporates the electromechanical coupling of the transducers, bonding effects and a mathematical model for the feedback signal conditioning circuitry. The resulting discrete degrees of freedom model is in the form of a set of coupled ordinary differential equations which describe the dynamic behavior of the active structure. To obtain the unknown dynamic coupling coefficients that represent the effects of bonding and other parameters of the model accurately, parameter identification methods were used. Modal control was also experimentally demonstrated. Dissert, Abstr.

# N87-26397\*# Carnegie Inst. of Tech., Pittsburgh, Pa. RESPONSE OF JOINT DOMINATED SPACE STRUCTURES Final Report

Aug. 1987 84 p (Contract NAG1-612)

(NASA-CR-181202; NAS 1.26:181202) Avail: NTIS HC A05/MF A01 CSCL 20K

An efficient linearization method is presented for calculating the transient response of nonlinear systems due to initial disturbances. The method is an extension of the describing function approach in which the steady state response of the system is calculated by representing the nonlinear element, typically joints in the case of space structures, by impedances which are functions of the amplitude of response. Thus, the problem of solving the differential equation for the steady state response becomes one of solving a set of nonlinear algebraic equations involving the steady state amplitudes and phases of the system. It is shown that for the transient case the steady state impedances can be averaged over the range of responses in order to provide equivalent values of stiffness and damping that, for a given set of initial displacements, may be treated as being constant for purposes of calculating system response. Single degree of freedom system are used to demonstrate the method and to develop an approach for optimizing the joint's characteristics so as to minimize transient response times. The use of this method for response estimation

and optimization in multiple degree of freedom systems is investigated. Author

N87-26583\*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.

PROJECTION FILTERS FOR MODAL PARAMETER ESTIMATE FOR FLEXIBLE STRUCTURES Progress Report, period ending 31 Dec. 1986

JEN-KUANG HUANG and CHUNG-WEN CHEN Feb. 1987 30 p (Contract NAG1-655)

(NASA-CR-180303; NAS 1.26:180303) Avail: NTIS HC A03/MF A01 CSCL 12A

Single-mode projection filters are developed for eigensystem parameter estimates from both analytical results and test data. Explicit formulations of these projection filters are derived using the pseudoinverse matrices of the controllability and observability matrices in general use. A global minimum optimization algorithm is developed to update the filter parameters by using interval analysis method. Modal parameters can be attracted and updated in the global sense within a specific region by passing the experimental data through the projection filters. For illustration of this method, a numerical example is shown by using a one-dimensional global optimization algorithm to estimate model frequencies and dampings.

N87-26921 Virginia Polytechnic Inst. and State Univ.,

AN INVESTIGATION OF METHODOLOGY FOR THE CONTROL AND FAILURE IDENTIFICATION OF FLEXIBLE STRUCTURES Ph.D. Thesis

ZEEN CHUL KIM 1986 129 p

Avail: Univ. Microfilms Order No. DA8704683

The characteristics of four methods is examined for the control of flexible structures and the control performances of each method. Various control performance measures, such as control gain magnitude, settling time and overshoot in transient response, actuator phase and gain margins, and stability in the presence of actuator failure are emphasized. In conjunction with the system performance, a systematic approach to the choice of weighting matrices for optimal control is presented. The approach shows a relation between the weighting matrices and the closed loop eigenvalues. The robustness of Independent Modal Space Control (IMSC) is examined. In general, the parameters of the control system are usually approximated, so that the designed controller, based on a postulated model, will not perform on the actual system as expected. It is shown that when the IMSC method is used with collocated sensors and actuators, the modelling errors in the postulated system cannot lead to instability of the closed loop system containing control modes and residual modes. However, in the case of coupled control (MGPP), this property cannot be shown. This points to the robustness of the IMSC method with respect to the modelling errors.

N87-27259# Virginia Polytechnic Inst. and State Univ., Blacksburg.
THE EFFECT OF NONLINEARITIES ON FLEXIBLE STRUCTURES Annual Report, 30 Apr. 1986 - 30 Apr. 1987

A. H. NAYFEH and D. T. MOOK 30 Apr. 1987 9 p (Contract AF-AFOSR-0090-86)

(AD-A181735; AFOSR-87-0712TR) Avail: NTIS HC A02/MF A01 CSCI 20K

Experimental-theoretical studies have been conducted on the influence of nonlinearities on flexible structures in the presence of an external or а parametric excitation. single-degree-of-freedom system with quadratic and cubic nonlinearities under the influence of a harmonic parametric excitation was studied using the method of multiple scales and digital-and analog-computer simulations. A global bifurcation diagram was obtained showing the different possible attractors (point, limit cycle, chaotic attractors). For small excitation amplitudes, the perturbation results are in excellent agreement with the digital- and analog-computer simulations. For moderate to large excitation amplitudes, the accuracy of the perturbation solution is questionable and only digital- and analog-computer simulations were used. The results are in full agreement. GRA

N87-27260\*# Old Dominion Univ., Norfolk, Va. Dept. of Civil Engineering.

SUBSTRUCTURE ANALYSIS USING NICE/SPAR AND APPLICATIONS OF FORCE TO LINEAR AND NONLINEAR STRUCTURES Progress Report, period ending 30 Jun. 1987 ZIA RAZZAQ, VENKATESH PRASAD, SIVA PRASAD DARBHAMULLA, RAVINDER BHATI, and CAI LIN Aug. 1987 129 n

(Contract NAG1-438)

(NASA-CR-180317; NAS 1.26:180317) Avail: NTIS HC A07/MF A01 CSCL 20K

Parallel computing studies are presented for a variety of structural analysis problems. Included are the substructure planar analysis of rectangular panels with and without a hole, the static analysis of space mast, using NICE/SPAR and FORCE, and substructure analysis of plane rigid-jointed frames using FORCE. The computations are carried out on the Flex/32 MultiComputer using one to eighteen processors. The NICE/SPAR runstream samples are documented for the panel problem. For the substructure analysis of plane frames, a computer program is developed to demonstrate the effectiveness of a substructuring technique when FORCE is enforced. Ongoing research activities for an elasto-plastic stability analysis problem using FORCE, and stability analysis of the focus problem using NICE/SPAR are briefly summarized. Speedup curves for the panel, the mast, and the frame problems provide a basic understanding of the effectiveness of parallel computing procedures utilized or developed, within the domain of the parameters considered. Although the speedup curves obtained exhibit various levels of computational efficiency, they clearly demonstrate the excellent promise which parallel computing holds for the structural analysis problem. Source code is given for the elasto-plastic stability problem and the FORCE program.

Author

N87-27705# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.

MAXIMUM LIKELIHOOD PARAMETER IDENTIFICATION OF FLEXIBLE SPACECRAFT Ph.D. Thesis

QI PING CHU 1987 272 p Sponsored by the Chinese Academy of Sciences, and Technische Hogeschool, Delft, The Netherlands

(ETN-87-90235) Avail: NTIS HC A12/MF A01

The finite element method is applied to generate a linear mathematical model of a general flexible spacecraft in arbitrary orbits. Model order is reduced by a quasi-static approximation of the higher frequency characteristic modes. Stochastic models to approximate modeling errors are proposed. The models for parameter estimation are linear dynamical systems with unknown process noise. Algorithms for maximum likelihood parameter estimation which account for correlations between process and measurement noise are developed. Simulated measurements are used to verify the applicability of the maximum likelihood parameter estimation algorithms to the identification of flexible spacecraft. It is demonstrated that for the spacecraft used, all unknown parameters can be estimated from the simulated measurements simultaneously with the time histories of the system model states.

N87-27713\* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. PRELOADED SPACE STRUCTURAL COUPLING JOINTS

atent

MARVIN D. RHODES, inventor (to NASA) 4 Aug. 1987 10 p Filed 30 Jul. 1986 Supersedes N86-21630 (24 - 23, p 3565 (NASA-CASE-LAR-13489-1; US-PATENT-4,684,156; US-PATENT-APPL-SN-890445; US-PATENT-CLASS-285-27; US-PATENT-CLASS-285-31; US-PATENT-CLASS-285-86; US-PATENT-CLASS-285-373; US-PATENT-CLASS-285-421; US-PATENT-CLASS-403-341) Avail: US Patent and Trademark Office CSCL 22B

A coupling device for tubular members of large truss structures with a locking collar being the only moving part is described. Each tubular member is constructed with an end bell section that has a belled flange with a mating face, and a necked area which is smaller in diameter than the tubular members to be joined. A split ring is affixed to each tubular member and is constructed so that when two tubular members are laterally moved into axial alignment and the collar is rotated over it, the split ring loads the joint with axial forces by pressing the belled flange mating surfaces together, and a preloading force is provided by the collar mating with a taper on the outside of the split rings. All free play is thereby removed by preloaded force. A major object is to provide an ability to remove and replace individual tubular members without disturbing other structural parts of a truss structure. An additional anticipated use of this joint is to couple high pressure fluid lines.

Official Gazette of the U.S. Patent and Trademark Office

# N87-28581\*# Boeing Aerospace Co., Seattle, Wash. SPACE STATION INTEGRATED WALL DESIGN AND PENETRATION DAMAGE CONTROL Final Report

A. R. CORONADO, M. N. GIBBINS, M. A. WRIGHT, and P. H. STERN Jul. 1987 257 p (Contract NAS8-36426)

(NASA-CR-179165; NÁS 1.26:179165; D180-30550-1) Avail: NTIS HC A12/MF A01 CSCL 22B

A methodology was developed to allow a designer to optimize the pressure wall, insulation, and meteoroid/debris shield system of a manned spacecraft for a given spacecraft configuration and threat environment. The threat environment consists of meteoroids and orbital debris, as specified for an arbitrary orbit and expected lifetime. An overall probability of no penetration is calculated, as well as contours of equal threat that take into account spacecraft geometry and orientation. Techniques, tools, and procedures for repairing an impacted and penetrated pressure wall were developed and tested. These techniques are applied from the spacecraft interior and account for the possibility of performing the repair in a vacuum. Hypervelocity impact testing was conducted to: (1) develop and refine appropriate penetration functions, and (2) determine the internal effects of a penetration on personnel and equipment.

# N87-28582\*# Boeing Aerospace Co., Seattle, Wash. SPACE STATION INTEGRATED WALL DESIGN AND PENETRATION DAMAGE CONTROL. TASK 3: THEORETICAL ANALYSIS OF PENETRATION MECHANICS Final Report

M. D. BJORKMAN, J. D. GEIGER, and E. E. WILHELM Jul. 1987 150 p

(Contract NAS8-36426)

(NASA-CR-179166; NAS 1.26:179166; D180-30550-2) Avail: NTIS HC A07/MF A01 CSCL 22B

The efforts to provide a penetration code called PEN4 version 10 is documented for calculation of projectile and target states for the impact of 2024-T3 aluminum, R sub B 90 1018 steel projectiles and icy meteoroids onto 2024-T3 aluminum plates at impact velocities from 0 to 16 km/s. PEN4 determines whether a plate is perforated by calculating the state of fragmentation of projectile and first plate. Depth of penetration into the second to sup th plate by fragments resulting from first plate perforation is determined by multiple cratering. The results from applications are given.

# N87-28937 California Inst. of Tech., Pasadena. AN EXPERIMENTAL INVESTIGATION OF VIBRATION SUPPRESSION IN LARGE SPACE STRUCTURES USING POSITIVE POSITION FEEDBACK Ph.D. Thesis

JAMES L. FANSON 1987 204 p

Avail: Univ. Microfilms Order No. DA8710938

A new technique for vibration suppression in Large Space Structures is demonstrated in laboratory experiments on a thin cantilever beam, resulting in substantially reduced dynamic response. This technique, called Positive Position Feedback (PPF),

makes use of generalized displacement measurements to accomplish vibration suppression. The concept of a piezoelectric active-member is developed in relation to controlling space-truss type structures. The active-member functions dually as a structural member and a control actuator. Piezoelectric ceramic material is adhered to a thin cantilever beam and simulates the use of an active-member. This space-realizable control scheme makes use of strain measurements, a preferred measurement quantity for vibration suppression, and internal control forces which completely decouple the rigid-body motion from the elastic motion. A simple necessary and sufficient condition for stability with PPF presented. This condition is nondynamic and is in general easily satisfied. As a result, PPF is demonstrated to have superior robust stability properties. It is also demonstrated that with PPF, all control and observation spillover is stabilizing. Five experiments are described. Dissert. Abstr.

N87-29012# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

### THE EXTENDABLE AND RETRACTABLE MAST AS SUPPORTING TOOL FOR RIGID SOLAR ARRAYS

M. SCHMID In ESA Proceedings of the Fifth European Symposium on Photovoltaic Generators in Space p 377-383 Nov. 1986 Avail: NTIS HC A21/MF A01

The Extendable and Retractable Mast (ERM) was developed to deploy and retract large foldable structures like solar arrays. By adequate choice of the interfaces between solar array and ERM it is possible to deploy, position, and retract large rollable or foldable, rigid, or flexible solar arrays up to the 40 m deployment range. Since for the attachment of rollable and foldable solar arrays only a tip and base interface on the ERM is necessary, different configurations providing intermediate attachment points along the mast were investigated to deploy and retract rigid solar array panels also.

**N87-29576\*** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

## TECHNOLOGY FOR LARGE SPACE SYSTEMS, A BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 17)

Oct. 1987 140 p

(NASA-SP-7046(17); NAS 1.21:7046(17)) Avail: NTIS HC A07 CSCL 22B

This bibliography lists 512 reports, articles, and other documents introduced into the NASA scientific and technical information system between January 1, 1987 and June 30, 1987. Its purpose is to provide helpful information to the researcher, manager, and designer in technology development and mission design according to system, interactive analysis and design, structural and thermal analysis and design, structural concepts and control systems, electronics, advanced materials, assembly concepts, propulsion, and solar power satellite systems.

N87-29590\*# Columbia Univ., New York, N.Y. Dept. of Civil Engineering and Engineering Mechanics.

### VIBRATIONS AND STRUCTUREBORNE NOISE IN SPACE STATION Final Report

R. VAICAITIS, C. S. LYRINTZIS, and D. A. BOFILIOS 9 Oct. 1987 152 p

(Contract NAG1-541)

(NASA-CR-181381; NAS 1.26:181381) Avail: NTIS HC A08/MF

Analytical models were developed to predict vibrations and structureborne noise generation of cylindrical and rectangular acoustic enclosures. These models are then used to determine structural vibration levels and interior noise to random point input forces. The guidelines developed could provide preliminary information on acoustical and vibrational environments in space station habitability modules under orbital operations. The structural models include single wall monocoque shell, double wall shell, stiffened orthotropic shell, descretely stiffened flat panels, and a coupled system composed of a cantilever beam structure and a stiffened sidewall. Aluminum and fiber reinforced composite materials are considered for single and double wall shells. The

end caps of the cylindrical enclosures are modeled either as single or double wall circular plates. Sound generation in the interior space is calculated by coupling the structural vibrations to the acoustic field in the enclosure. Modal methods and transfer matrix techniques are used to obtain structural vibrations. Parametric studies are performed to determine the sensitivity of interior noise environment to changes in input, geometric and structural conditions.

N87-29859\*# AEC-Able Engineering Co., Inc., Goleta, Calif. FOLDING, ARTICULATED, SQUARE TRUSS

ROBERT M. WARDEN In NASA-Lyndon B. Johnson Space Center, The 21st Aerospace Mechanisms Symposium p 1-17 May 1987

Avail: NTIS HC A16/MF A01 CSCL 131

A larger, stronger deployable boom was developed to handle the requirements of larger, heavier payloads in space. The main components of the boom and its deployer are described and their functions explained. Desirable features of the boom are identified and physical properties are reported.

Author

N87-29860\*# Toshiba Corp., Kanagawa (Japan). Research and Development Center.

THE DESIGN AND DEVELOPMENT OF A TWO-DIMENSIONAL ADAPTIVE TRUSS STRUCTURE

FUMIHIRO KUWAO, SHOICHI MOTOHASHI, MAKOTO YOSHIHARA, KENICHI TAKAHARA, and MICHIHIRO NATORI (Tokyo Univ., Japan) /n NASA-Lyndon B. Johnson Space Center, The 21st Aerospace Mechanisms Symposium p 19-34 May 1987

Avail: NTIS HC A16/MF A01 CSCL 131

The functional model of a two dimensional adaptive truss structure which can purposefully change its geometrical configuration is introduced. The details of design and fabrication such as kinematic analysis, dynamic characteristics analysis and some test results are presented for the demonstration of this two dimensional truss concept.

Author

N87-29864\*# RCA Aerospace and Defense, East Windsor, N.J. Astro-Space Div.

DEVELOPMENT OF A STANDARD CONNECTOR FOR ORBITAL REPLACEMENT UNITS FOR SERVICEABLE SPACECRAFT

ELLEN F. HEATH, MATTHEW A. BRACCIO, STEVEN D. RAYMUS, and DAVID W. GROSS In NASA-Lyndon B. Johnson Space Center, The 21st Aerospace Mechanisms Symposium p 81-92 May 1987

Avail: NTIS HC A16/MF A01 CSCL 22B

The current trend for spacecraft to be serviceable and repairable in orbit has led to a modular approach to satellite subsystem design. Spacecraft equipment, such as sensors, tape recorders, computers, transponders, batteries, etc., housed in discrete modular units, (Orbital Replacement Units(ORUs)) can be attached and detached to the spacecraft as needed. The interface between the ORU and the spacecraft is crucial. The projected use of robotics and the need for a common mechanism capable of performing several functions puts many constraints on the design of the interface. Such an interface mechanisms was designed and developed called the Standard Interface Connector (SIC) that mates the ORU to the spacecraft. The SIC also provides for the flow of fluids, data, and power between the module and spacecraft. The baseline design presented can be configured to provide various attachment schemes. Tests on SIC models have demonstrated the functionality of the design and its compatibility with current Author robotics.

N87-29898\*# Catholic Univ. of America, Washington, D.C. Dept. of Mechanical Engineering.

OPTIMUM SHAPE CONTROL OF FLEXIBLE BEAMS BY PIEZO-ELECTRIC ACTUATORS

A. BAZ and S. POH 1987 35 p
(Contract NAG5-520; NAG5-749)

(NASA-CR-181413; NAS 1.26:181413) Avail: NTIS HC A03/MF A01 CSCL 20K

The utilization of piezoelectric actuators in controlling the static deformation and shape of flexible beams is examined. An optimum design procedure is presented to enable the selection of the optimal location, thickness and excitation voltage of the piezoelectric actuators in a way that would minimize the deflection of the beam to which these actuators are bonded. Numerical examples are presented to illustrate the application of the developed optimization procedure in minimizing structural deformation of beams using ceramic and polymeric piezoelectric actuators bonded to the beams with a typical bonding agent. The obtained results emphasize the importance of the devised rational produce in designing beam-actuator systems with minimal elastic distortions. Author

N87-29899\*# George Washington Univ., Washington, D.C. Joint Inst. for Advancement of Flight Sciences.

COMPUTATIONAL PROCEDURES FOR EVALUATING THE SENSITIVITY DERIVATIVES OF VIBRATION FREQUENCIES AND EIGENMODES OF FRAMED STRUCTURES

TIMOTHY L. FETTERMAN and AHMED K. NOOR Washington NASA Oct. 1987 88 p (Contract NAG1-728)

(NASA-CR-4099; NAS 1.26:4099) Avail: NTIS HC A05/MF A01 CSCL 20K

Computational procedures are presented for evaluating the sensitivity derivatives of the vibration frequencies and eigenmodes of framed structures. Both a displacement and a mixed formulation are used. The two key elements of the computational procedure are: (a) Use of dynamic reduction techniques to substantially reduce the number of degrees of freedom; and (b) Application of iterative techniques to improve the accuracy of the derivatives of the eigenmodes. The two reduction techniques considered are the static condensation and a generalized dynamic reduction technique. Error norms are introduced to assess the accuracy of the eigenvalue and eigenvector derivatives obtained by the reduction techniques. The effectiveness of the methods presented is demonstrated by three numerical examples.

#### 04

#### THERMAL CONTROL

Includes descriptions of analytical techniques, passive and active thermal control techniques, external and internal thermal experiments and analyses and trade studies of thermal requirements.

A87-32175\*# Texas A&M Univ., College Station.

DETERMINATION OF THE CROSS-SECTIONAL

TEMPERATURE DISTRIBUTION AND BOILING LIMITATION

OF A HEAT PIPE

G. P. PETERSON (Texas A & M University, College Station) Journal of Thermophysics and Heat Transfer (ISSN 0887-8722), vol. 1, April 1987, p. 189-192. (Contract NAS8-4496)

A computer model is developed and verified which is capable of determining the cross-sectional temperature distribution within a heat pipe with an attached radiator fin; such heat pipes would be plugged into contact heat exchangers designed to carry heat from a space station habitation module to the radiator elements through a centralized fluid loop. The model can furnish information for determining the susceptibility of the monogroove heat pipe to boiling, as well as the location and magnitude of that boiling.

A THERMALLY-PUMPED HEAT TRANSPORT SYSTEM
TETSURO OGUCHI, MASAAKI MURAKAMI (Mitsubishi Electric
Corp., Central Research Laboratory, Amagasaki, Japan), YASUSHI

A87-32369

40

SAKURAI, and HIROAKI MATSUDA (Mitsubishi Electric Corp., Kamakura Works, Japan) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 1 . Tokyo, AGNE Publishing, Inc., 1986, p. 703-710.

This paper describes a new concept of heat transport system, the 'thermal pump system', which offers advantages with respect to the present state of heat transport technology. This system is a two-phase flow loop which consists of an evaporator, a condenser, two accumulators with pumping heaters and four check valves. R 11 is used as a working fluid. Condensed liquid is pumped up from the condenser to the evaporator by the driving force produced by pressure oscillation, which is generated by the periodic heating of the pumping heaters attached to the accumulators. The heat transport characteristics of the system were theoretically and experimentally investigated. The required heat for the liquid pumping and the means for reducing the pumping heat were analyzed. Temperature and pressure distributions under a certain amount of heat transfer rate were predicted by an operation model presented here. In the operation model, mass and heat conservation and pressure drop were taken into consideration. The prediction agreed well with the experimental data.

#### A87-32377

### HIGH THERMAL CAPACITY EVAPORATOR AND CONDENSERS FOR SPACE STATION THERMAL CONTROL

HAN HWANGBO and W. S. MCEVER (MRJ, Inc., Oakton, VA) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 1. Tokyo, AGNE Publishing, Inc., 1986, p. 755-760.

Pumped two-phase thermal control systems have a number of advantages over conventional single phase systems such as used on the Shuttle Orbiter. These advantages include reduced weight and higher thermal efficiency. In contrast to single phase systems, however, a two-phase fluid loop is much more sensitive to the effects of a 0-gravity environment. At MRJ several promising concepts for evaporator and condenser design for 0-g operation have been investigated. In this paper the design and control concepts are discussed and results of performance analyses are presented. The proposed evaporator/condenser concepts are widely applicable to any thermal control system such as for laser mirror cooling that requires high heat flux capability with minimum mechanical complexity.

#### A87-32662

### DEVELOPMENT STATUS OF A TWO-PHASE THERMAL MANAGEMENT SYSTEM FOR LARGE SPACECRAFT

TIMOTHY J. BLAND, ING-YOMN CHEN, and DAVID G. C. HILL (Sundstrand Corp., Rockford, IL) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 13-16, 1986 9 p (SAE PAPER 861828)

Design features and results from testing of a prototype components of a two-phase thermal management system (TPTMS) for the Space Station are summarized. The TPTMS is comprised of an evaporator (heat addition) loop and a condenser (heat rejection) loop, both of which interface through a rotary fluid management device (RFMD). System functions which are to transfer heat from the Station to space through radiators are described, noting methods which keep the RFMD hot end at a constant temperature to control the liquid temperatures inside the evaporator. The TPTMS has been configured to accommodate growth loads to avoid the need for future capacity upgrades. Results are provided from tests of prototype RFMD, condenser and back pressure regulator valve. The assembled prototype is to undergo hypergravity and microgravity flight tests on a KC-135 aircraft.

M.S.K.

# A87-32663\* RCA Astro-Electronics Div., Princeton, N. J. DESIGN OF AN ADVANCED TWO-PHASE CAPILLARY COLD PLATE

D. R. CHALMERS (RCA, Astro-Electronics Div., Princeton, NJ), E. J. KROLICZEK, and J. KU (OAO Corp., Greenbelt, MD) SAE,

Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 13-16, 1986. 12 p. refs (Contract NAS5-29248) (SAE PAPER 861829)

The functional principles and implementation of capillary pumped loop (CPL) two phase heat transport system for various elements of the Space Station program are described. Circulation of the working fluid by the surface-tension forces in a fine-pore capillary wick is the core principle of CPL systems. The liquid, usually NH3 at the moment, is changed into a vapor by heat absorption at one end of the loop, and the vapor is carrried back along the wick by the surface tension within the wick. NASA specifications and the results of mechanical and thermal tests for prototype cold plate and the capillary pump designs are outlined. The CPL is targeted for installation on free-flying platforms, attached payloads, and power subsystem thermal control systems. M.S.K.

#### A87-32665

### ENVIRONMENTAL AVOIDANCE CONCEPTS FOR STEERABLE SPACE STATION RADIATORS

B. L. HEIZER, G. D. RHODES, S. D. GOO, and D. W. THORESON (Boeing Aerospace Co., Seattle, WA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 13-16, 1986. 13 p.

(SAE PAPER 861831)

The systems rotary fluid coupling (RFC) concepts being studied for the Space Station steerable radiators are described. Steerable radiators are needed to handle the large thermal loads of the Station. The control system logic must identify the current position of the radiator with respect to the sun, the orbital position of the Station, and the operating temperature of the system. The logic must include the capability of pointing the radiators to minimize environmental damage to the radiators, i.e., select the minimal thermal environment and/or an appropriate position during warm-up of the radiators during minimal load periods. Design features of five sensor arrays which are candidates for meeting the 10 yr lifetime without component replacement, indefinite life with replacement, and 99 percent reliability specifications are described, along with the tradeoff studies being used in the evaluations.

M.S.K.

# A87-32666\* Hughes Aircraft Co., Torrance, Calif. HIGH CAPACITY DEMONSTRATION OF HONEYCOMB PANEL HEAT PIPES

H. J. TANZER, M. R. CERZA, JR. (Hughes Aircraft Co., Torrance, CA), and J. B. HALL (NASA, Langley Research Center, Hampton, VA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 13-16, 1986. 18 p. refs (SAE PAPER 861833)

High capacity honeycomb panel heat pipes were investigated as heat rejection radiators on future space platforms. Starting with a remnant section of honeycomb panel measuring 3.05-m long by 0.127-m wide that was originally designed and built for high-efficiency radiator fins, features were added to increase thermal transport capacity and thus permit test evaluation as an integral heat transport and rejection radiator. A series of subscale panels were fabricated and reworked to isolate individual enhancement features. Key to the enhancement was the addition of a liquid sideflow that utilizes pressure priming. A prediction model was developed and correlated with measured data, and then used to project performance to large, space-station size radiators. Results show that a honeycomb panel with 5.08-cm sideflow spacing and core modification will meet the design load of a 50 kW space heat rejection system. Author

# A87-32668\* Boeing Aerospace Co., Seattle, Wash. PROTOTYPE THERMAL BUS FOR MANNED SPACE STATION COMPARTMENTS

RONALD C. ZENTNER (Boeing Aerospace Co., Seattle, WA) and JAMES W. OWEN (NASA, Marshall Space Flight Center, Huntsville, AL) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 13-16, 1986. 13 p. (SAE PAPER 861825)

A summary is presented of NASA efforts, to February 1986. on development of an advanced thermal bus for manned spacecraft. Design details are described for a prototype to be tested in 1987 that includes a contact heat exchanger, an air cooling heat exchanger for manned cabin conditions, and an interface heat exchanger for transferring compartment heat loads to the Space Station Central Thermal Bus. The design and performance criteria defined for the thermal bus are outlined and results are reported from comparisons of the capabilities and costs of pumped water and operational evaporating/condensing heat transport concepts. The operating temperature, launch weight/thermal performance ratios, and power requirements of each concept are discussed, along with the critical technologies identified for use of a water/titanium two-phase thermal bus.

**A87-34469\***# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

## THERMAL DESIGN OF THE ACCESS ERECTABLE SPACE TRUSS

OBIE H. BRADLEY, JR. and RICHARD A. FOSS (NASA, Langley Research Center, Hampton, VA) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 24, Mar.-Apr. 1987, p. 188-192. Previously cited in issue 17, p. 2472, Accession no. A85-37658. refs

#### A87-38725

### THE CAPABILITIES OF EURECA THERMAL CONTROL FOR FUTURE MISSION SCENARIOS

B. SCHWARZ, K. BECKMANN, D. STUEMPEL (MBB-ERNO Raumfahrttechnik GmbH, Bremen, West Germany), and P. TAMBURINI (ESA, European Space Research and Technology Centre, Noordwijk, Netherlands) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 225-233.

(SAE PAPER 860936)

Attention is given to the thermal control system configuration and functions of the European Retrievable Carrier (Eureca) spacecraft, which will be lofted into orbit by the NASA Space Shuttle in 1988 and is designed to perform a total of five free-flying missions of 6-month duration initially. Future missions, however, will entail extended lifetimes and a purely passive Thermal Control Subsystem design. The requirements of the Eureca Sophya solar region studies mission and Gretel X- and gamma-ray detection mission.

# A87-38734\* United Technologies Corp., Windsor Locks, Conn. REGENERABLE NON-VENTING THERMAL CONTROL SUBSYSTEM FOR EXTRAVEHICULAR ACTIVITY

GEORGE J. ROEBELEN, STEPHEN A. BAYES (United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT), and B. MIKE LAWSON (NASA, Johnson Space Center, Houston, TX) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 345-355. (SAE PAPER 860947)

Routine and complex EVAs call for more effective heat rejection systems in order to maximize mission productivity; an optimum EVA mobility unit (EMU) thermal control subsystem must require no expendables and introduce no contaminants into the environment, while conforming to minimum size limits and allowing easy regeneration. Attention is presently given to two thermal control subsystems, one of which can be integrated with the existing Space Shuttle Orbiter EMU to provide a 3-hour nonventing heat rejection capability, while the other can furnish the entire heat rejection capability requirement for an 8-hour Space Station EVA.

A87-38743

#### QUALITY MONITORING IN TWO-PHASE HEAT TRANSPORT SYSTEMS FOR LARGE SPACECRAFT

A. A. M. DELIL (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 439-452. refs

(SAE PAPER 860959)

Two-phase heat transport systems are currently considered for the thermal management of future large power spacecraft. The monitoring of the quality, being the relative vapor mass content, of the two-phase mixture at various locations in the system, is valuable - possibly indispensable - for the proper operation of such a system. This paper reviews concepts for quality monitoring. Only a few concepts turn out to be suitable for spacecraft applications. Promising concepts are based on the capacitance, sonic velocity and index of refraction. These concepts are described and quantitatively analyzed. Applicability, advantages, restrictions and some hardware aspects are discussed.

#### A87-38760

### ENHANCED EVAPORATIVE SURFACE FOR TWO-PHASE MOUNTING PLATES

M. G. GROTE, J. A. STARK, and E. C. TEFFT, III (McDonnell Douglas Corp., Saint Louis, MO) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 617-626.

(SAE PAPER 860979)

An enhancement method for a grooved, evaporative surface for two-phase mounting plates which could be used in two-phase thermal control systems, such as that on the proposed Space Station is presented. An aluminum plate is machined with fine, rectangular grooves (39 grooves/cm). This grooved surface is then enhanced by an inexpensive process called Ivadizing, during which aluminum is vapor-deposited onto the surface, forming a slightly porous coating on the area between the grooves. The resulting surface has a much larger evaporative heat transfer coefficient and capillary pumping ability than that of plain rectangular grooves. Tests of this plate with R-11 showed improvement in evaporative heat transfer coefficient by a factor of 4. Analytic studies show that this enhanced surface should have at least three times the capillary pumping capacity of the rectangular grooved surface.

Author

A87-38775\* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

### EVALUATION OF SPACE STATION THERMAL CONTROL TECHNIQUES

J. B. HALL (NASA, Langley Research Center, Hampton, VA), GENE T. COLWELL, and JAMES G. HARTLEY (Georgia Institute of Technology, Atlanta) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 791-804. refs

(SAE PAPER 860998)

A procedure is developed for evaluating various candidates for thermal control in the orbiting Space Station. Candidates for acquisition, transport and rejection are considered. For example, thermal rejection candidates include heat pipe radiators, high capacity heat pipe radiators and liquid droplet radiators. A computer program has been developed which computes subsystem and total system weights, volumes, powers and costs for a system consisting of selected acquisition, transport and rejection candidates. The program user is also able to select mission parameters such as duration, resupply interval, thermal loads, transport distance, acquisition temperature and rejection temperature. Simulation models are included in the program which allow the user to change candidate designs. For example, for a high capacity heat pipe

radiator the user may change working fluid, materials, radiator temperature, radiator geometry, surface emissivity and surface absorptivity. The program also allows the selection of several different acquisitions of thermal energy at different temperatures using different acquisition candidates.

Author

#### A87-38776

### OPTIMIZATION OF HEAT REJECTION SUBSYSTEM FOR SOLAR DYNAMIC BRAYTON CYCLE POWER SYSTEM

RICHARD PEARSON and DAVID DABROWSKI (Grumman Aerospace Corp., Bethpage, NY) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 805-815.

(SAE PAPER 860999)

A closed Brayton cycle (CBC) powerplant is under consideration for the Space Station Solar Dynamic Power System; attention is presently given to the weight, volume and cost optimization of the CBC's heat rejection system, on whose performance the power generation efficiency of the entire apparatus is strongly dependent. An analysis of the effects of varying system parameters on the radiator area and weight requirement indicates that radiator area is strongly dependent on radiator physical design. Radiator size depends on the arrangement, size, and design point heat rejection of the radiator panels, as well as such radiator properties as fin effectiveness, emissivity, and absorptivity.

O.C.

#### A87-43003#

### SPACE STATION ACTIVE THERMAL CONTROL SYSTEM MODELLING

ROSEMARY SCHMIDT and ERIC GUSTAFSON (Grumman Aerospace Corp., Space Systems Div., Bethpage, NY) AIAA, Thermophysics Conference, 22nd, Honolulu, HI, June 8-10, 1987. 8 p.

(AIAA PAPER 87-1468)

This paper describes a unique thermal modelling method that was devised to model the Grumman design of the Space Station Active Thermal Control System (ATCS). The ATCS utilizes a two-phase thermal bus for acquiring and transporting heat to heat pipe radiators, which reject the waste heat to space. The mathematical modelling and analysis of these systems required the development of new modelling methods. The SINDA thermal analyzer program was used for the modelling, but since this program has no two-phase flow analysis capability, several additional routines were developed. These routines were then used in conjunction with the SINDA thermal analyzer for modelling the two-phase flow in the thermal bus. This work was performed for NASA as part of the Space Station Work Package 2 phase B study.

#### A87-43014#

### THE BENEFIT OF PHASE CHANGE THERMAL STORAGE FOR SPACECRAFT THERMAL MANAGEMENT

M. S. BUSBY and S. J. MERTESDORF (TRW, Inc., TRW Space and Technology Group, Redondo Beach, CA) AIAA, Thermophysics Conference, 22nd, Honolulu, HI, June 8-10, 1987. 8 p. refs

(AIAA PAPER 87-1482)

This paper discusses the applications of thermal storage in spacecraft which are beneficial for weight savings. Tools are developed which allow a thermal system designer to perform preliminary thermal performance and weight trades on systems with thermal storage and those without. Thermal storage module designs which achieve high performance are also discussed. Analysis is performed to assess the impact of two heating profiles representative of typical spacecraft missions: a pulse power profile and the absolute value of a sinusoidal profile. The pulse power profile is typical of surveillance spacecraft dissipation and the sinusoidal profile represents solar heating. Using the tools developed in the paper, it was found that thermal storage can be valuable in reducing the system weight for pulsed heating with

short pulse duration and for solar heating with short orbit periods.

Author

A87-43048\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

LIQUID SHEET RADIATOR

DONALD L. CHUBB and K. ALLAN WHITE, III (NASA, Lewis Research Center, Cleveland, OH) AIAA, Thermophysics Conference, 22nd, Honolulu, HI, June 8-10, 1987. 12 p. Previously announced in STAR as N87-18786. refs (AIAA PAPER 87-1525)

A new external flow radiator concept, the liquid sheet radiator (LSR), is introduced. The LSR sheet flow is described and an expression for the length/width (I/w) ratio is presented. A linear dependence of I/w on velocity is predicted that agrees with experimental results. Specific power for the LSR is calculated and is found to be nearly the same as the specific power of a liquid droplet radiator (LDR). Several sheet thicknesses and widths were experimentally investigated. In no case was the flow found to be unstable.

**A87-43059\***# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

#### LIQUID DROPLET RADIATOR DEVELOPMENT STATUS

K. ALAN WHITE, III (NASA, Lewis Research Center, Cleveland, OH) AlAA, Thermophysics Conference, 22nd, Honolulu, HI, June 8-10, 1987. 21 p. Previously announced in STAR as N87-20353. refs

(AIAA PAPER 87-1537)

Development of the Liquid Droplet Radiator (LDR) is described. Significant published results of previous investigators are presented, and work currently in progress is discussed. Several proposed LDR configurations are described, and the rectangular and triangular configurations currently of most interest are examined. Development of the droplet generator, collector, and auxiliary components are discussed. Radiative performance of a droplet sheet is considered, and experimental results are seen to be in very good agreement with analytical predictions. The collision of droplets in the droplet sheet, the charging of droplets by the space plasma, and the effect of atmospheric drag on the droplet sheet are shown to be of little consequence, or can be minimized by proper design. The LDR is seen to be less susceptible than conventional technology to the effects of micrometeoroids or hostile threats. The identification of working fluids which are stable in the orbital environments of interest is also made. Methods for reducing spacecraft contamination from an LDR to an acceptable level are discussed. Preliminary results of microgravity testing of the droplet generator are presented. Possible future NASA and Air Force missions enhanced or enabled by a LDR are also discussed. System studies indicate that the LDR is potentially less massive than heat pipe radiators. Planned microgravity testing aboard the Shuttle or space station is seen to be a logical next step in LDR development.

A87-43103\*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

THE DEFINITION OF THE LOW EARTH ORBITAL

# ENVIRONMENT AND ITS EFFECT ON THERMAL CONTROL MATERIALS

J. T. DURCANIN, D. R. CHALMERS (RCA Aerospace and Defense, RCA Astro-Space Div., Princeton, NJ), and J. T. VISENTINE (NASA, Johnson Space Center, Houston, TX) AlAA, Thermophysics Conference, 22nd, Honolulu, HI, June 8-10, 1987. 13 p. refs (AlAA PAPER 87-1599)

The LEO environment and its effects on thermal-control materials (TCMs) being evaluated for use in long-term-mission space structures such as the Space Station are characterized, summarizing the results of recent space and laboratory experiments. Factors examined include atomic oxygen (a serious problem out to 600-700 km), ionizing radiation, solar UV radiation, solid particles (manmade debris and micrometeoroids, a significant hazard out to about 1000 km), and synergistic effects. Numerical data on the expected intensity of these effects for the different

Space Station components, the resistance of specific TCMs to the effects, and the effectiveness of protective coatings are compiled in extensive tables and illustrated with diagrams, graphs, and micrographs.

T.K.

# A87-43125\*# Grumman Aerospace Corp., Bethpage, N.Y. THERMAL TEST RESULTS OF THE TWO-PHASE THERMAL BUS TECHNOLOGY DEMONSTRATION LOOP

FRED EDELSTEIN, MARIA LIANDRIS (Grumman Aerospace Corp., Bethpage, NY), and J. GARY RANKIN (NASA, Johnson Space Center, Houston, TX) AIAA, Thermophysics Conference, 22nd, Honolulu, HI, June 8-10, 1987. 9 p. refs (AIAA PAPER 87-1627)

A two-phase heat transport system, the Thermal Bus Technology Demonstrator, has been built and tested for NASA Johnson Space Center for application on Space Station. The loop is a separated two-phase system that uses evaporator flow control valves and liquid condenser flooding to achieve temperature control. Both ambient and thermal vacuum tests have been completed in NASA's Chamber A, initially using Freon-11 and then ammonia as the working fluid. Overall, the tests were quite successful, with the bus achieving all major test objectives, including operation at 19.5 kW and set points at 35 F (1.7 C), 70 F (21.1 C) and 104 F (40.0 C), load sharing, asymmetrical heating and isothermality around the loop. Low plate to vapor temperature drops were obtained for the monogroove cold plate using ammonia and are indicative of the high evaporative film coefficients obtainable with this design.

# A87-43126\*# Boeing Aerospace Co., Seattle, Wash. DEVELOPMENT OF A PROTOTYPE TWO-PHASE THERMAL BUS SYSTEM FOR SPACE STATION

D. L. MYRON (Boeing Aerospace Co., Seattle, WA) and R. C. PARISH (NASA, Johnson Space Center, Houston, TX) AIAA, Thermophysics Conference, 22nd, Honolulu, HI, June 8-10, 1987. 11 p. refs

(AIAA PAPER 87-1628)

This paper describes the basic elements of a pumped two-phase ammonia thermal control system designed for microgravity environments, the development of the concept into a Space Station flight design, and design details of the prototype to be ground-tested in the Johnson Space Center (JSC) Thermal Test Bed. The basic system concept is one of forced-flow heat transport through interface heat exchangers with anhydrous ammonia being pumped by a device expressly designed for two-phase fluid management in reduced gravity. Control of saturation conditions, and thus system interface temperatures, is accomplished with a single central pressure regulating valve. Flow control and liquid inventory are controlled by passive, nonelectromechanical devices. Use of these simple control elements results in minimal computer controls and high system reliability. Building on the basic system concept, a brief overview of a potential Space Station flight design is given. Primary verification of the system concept will involve testing at JSC of a 25-kW ground test article currently in fabrication.

# A87-44830\*# Washington Univ., Seattle. RADIATION HEAT TRANSFER CALCULATIONS FOR SPACE STRUCTURES

A. F. EMERY, O. JOHANSSON, and A. ABROUS (Washington, University, Seattle) AIAA, Thermophysics Conference, 22nd, Honolulu, HI, June 8-10, 1987. 7 p. refs (Contract NAG1-41) (AIAA PAPER 87-1522)

A method is presented for the computation of radiant heat flux between arbitrary surfaces which permits a user defined level of accuracy. The method can be applied to directionally dependent surface properties, specular radiation, or solar illumination, and ensures conservation of energy. The method is compared with others to demonstrate its value.

# A87-44843\*# General Dynamics Corp., San Diego, Calif. STRUCTURAL AND PRELIMINARY THERMAL PERFORMANCE TESTING OF A PRESSURE ACTIVATED CONTACT HEAT EXCHANGER

C. Y. LEE, E. L. CHRISTIAN, J. W. WOHLWEND (General Dynamics Corp., Space Systems Div., San Diego, CA), and R. C. PARISH (NASA, Johnson Space Center, Houston, TX) AIAA, Thermophysics Conference, 22nd, Honolulu, HI, June 8-10, 1987. 9 p.

(AIAA PAPER 87-1540)

A contact heat exchanger concept is being developed for use onboard Space Station as an interface device between external thermal bus and pressurized modules. The concept relies on mechanical contact activated by the fluid pressure inside thin-walled tubes. Structural testings were carried out to confirm the technology feasibility of using such thin-walled tubes. The test results also verified the linear elastic stress analysis which was used to predict the tube mechanical behaviors. A preliminary thermal testing was also performed with liquid Freon-11 flowing inside tubes and heat being supplied by electrical heating from the bottom of the contact heat exchanger baseplate. The test results showed excellent agreement of test data with analytical prediction for all thermal resistances except for the two-phase flow characteristics. Testing with two-phase flow inside tubes will, however, be performed on the NASA-JSC test bed.

# A87-45258# THERMAL DESIGN OF A LARGE SPACECRAFT PROPULSION SYSTEM

J. E. GENOVESE and J. L. GODWARD (United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 23rd, San Diego, CA, June 29-July 2, 1987. 7 p. (AIAA PAPER 87-1863)

A spacecraft propulsion system consisting of two propellant tanks capable of carrying 1900 pounds of hydrazine, six helium pressurant tanks, and 12 five-pound thrusters has been designed and qualified for an orbit transfer and station-keeping mission. The baseline mission imposed a severe power constraint on the thermal control subsystem. Attaining the power goal was complicated by the large size of the propulsion system and the severity of the environments. A thermal design evolved which incorporated the use high strength, low thermal conductivity titanium struts, multilayer insulation blankets with integral propulsion bay vents, and thermostatically controlled heaters. The ability to maintain all components within required temperature ranges was subsequently verified during thermal balance testing. Based on this testing, the orbital average power consumption of the thermal control subsystem is estimated to be less than 32 watts. Author

# A87-46682 EVALUATION OF THE INFRARED TEST METHOD FOR THE OLYMPUS THERMAL BALANCE TESTS

MARC DONATO, JERRY GREEN, DANY ST-PIERRE (Spar Aerospace, Ltd., Ste-Anne-de-Bellevue, Canada), and MURRAY REEVES (David Florida Laboratory, Ottawa, Canada) Journal of Environmental Sciences (ISSN 0022-0906), vol. 30, May-June 1987, p. 45-49. Research supported by the Canadian Department of Communications and Olympus Program.

The present work reports on the performance of the infrared test techniques developed and used for the thermal balance testing of the Olympus spacecraft thermal model. Developments in the area of computer software, radiometers, and temperature measurement systems are presented. The power control and data acquisition systems are detailed. A summary of the test results shows that temperature differences between test and predictions are in agreement within the values obtained in past programs for an uncorrelated mathematical model.

N87-20353\*# National Aeronautics and Space Administration.
Lewis Research Center, Cleveland, Ohio.
LIQUID DROPLET RADIATOR DEVELOPMENT STATUS

K. ALAN WHITE, III 1987 28 p Prepared for presentation at

the 22nd Thermophysics Conference, Honolulu, Hawaii, 8-10 Jul. 1987; sponsored by AIAA

(NASA-TM-89852; É-3510; NAS 1.15:89852) Avail: NTIS HC A03/MF A01 CSCL 22B

Development of the Liquid Droplet Radiator (LDR) is described. Significant published results of previous investigators are presented. and work currently in progress is discussed. Several proposed LDR configurations are described, and the rectangular and triangular configurations currently of most interest are examined. Development of the droplet generator, collector, and auxiliary components are discussed. Radiative performance of a droplet sheet is considered, and experimental results are seen to be in very good agreement with analytical predictions. The collision of droplets in the droplet sheet, the charging of droplets by the space plasma, and the effect of atmospheric drag on the droplet sheet are shown to be of little consequence, or can be minimized by proper design. The LDR is seen to be less susceptible than conventional technology to the effects of micrometeoroids or hostile threats. The identification of working fluids which are stable in the orbital environments of interest is also made. Methods for reducing spacecraft contamination from an LDR to an acceptable level are discussed. Preliminary results of microgravity testing of the droplet generator are presented. Possible future NASA and Air Force missions enhanced or enabled by a LDR are also discussed. System studies indicate that the LDR is potentially less massive than heat pipe radiators. Planned microgravity testing aboard the Shuttle or space station is seen to be a logical next step in LDR development.

N87-21021\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

ANALYSIS OF ON-ORBIT THERMAL CHARACTERISTICS OF THE 15-METER HOOP/COLUMN ANTENNA

GREGORY C. ANDERSEN, JEFFERY T. FARMER, and JAMES GARRISON (Rensselaer Polytechnic Inst., Troy, N.Y.) Mar. 1987 33 p

(NASA-TM-89137; NAS 1.15:89137) Avail: NTIS HC A03/MF A01 CSCL 22B

In recent years, interest in large deployable space antennae has led to the development of the 15 meter hoop/column antenna. The thermal environment the antenna is expected to experience during orbit is examined and the temperature distributions leading to reflector surface distortion errors are determined. Two flight orientations corresponding to: (1) normal operation, and (2) use in a Shuttle-attached flight experiment are examined. A reduced element model was used to determine element temperatures at 16 orbit points for both flight orientations. The temperature ranged from a minimum of 188 K to a maximum of 326 K. Based on the element temperatures, orbit position leading to possible worst case surface distortions were determined, and the subsequent temperatures were used in a static finite element analysis to quantify surface control cord deflections. The predicted changes in the control cord lengths were in the submillimeter ranges.

**Author** 

N87-26072\*# Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.

DEVELOPMENT OF AN EMULATION-SIMULATION THERMAL CONTROL MODEL FOR SPACE STATION APPLICATION Semiannual Status Report

JAMES G. HARTLEY and GENE T. COLWELL Jun. 1987 80 p (Contract NAG1-551)

(NASA-CR-181009; NAS 1.26:181009) Avail: NTIS HC A05/MF A01 CSCL 22B

An improved capability for comparing various techniques for thermal management in the Space Station was developed. Current planning for the orbiting space station calls for a dual keel configuration. The thermal control system (TCS) for the space is composed of a central TCS and internal thermal control system for the modules, as well as service facilities and attached payloads. The internal TCS may be attacted to the central TCS through a thermal bus. The central TCS is composed of a main transport system which collects waste thermal energy from each of the

modules and transports it through coolant lines to the main rejection system. The waste heat loads in the modules arise from electrical and electronic equipment as well as metabolic loads in the manned modules. Several candidate technologies are being considered for acquiring the waste heat loads, for transporting the thermal energy between the acquisition and rejection systems, and for rejecting the waste heat to space. The analysis techniques described were developed for use in evaluating reliability, weights, costs, volumes, and power requirements for configurations using different candidates and different mission parameters.

N87-26192\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

AN ELECTRICALLY CONDUCTIVE THERMAL CONTROL SURFACE FOR SPACECRAFT ENCOUNTERING LOW-EARTH ORBIT (LEO) ATOMIC OXYGEN INDIUM TIN OXIDE-COATED THERMAL BLANKETS Abstract Only

An organic black thermal blanket material was coated with indium tin oxide (ITO) to prevent blanket degradation in the low Earth orbit (LEO) atomic oxygen environment. The blankets were designed for the Galileo spacecraft. Galileo was initially intended for space shuttle launch and would, therefore, have been exposed to atomic oxygen in LEO for between 10 and 25 hours. Two processes for depositing ITO are described. Thermooptical, electrical, and chemical properties of the ITO film are presented as a function of the deposition process. Results of exposure of the ITO film to atomic oxygen (from a shuttle flight) and radiation exposure (simulated Jovian environment) are also presented. It is shown that the ITO-protected thermal blankets would resist the anticipated LEO oxygen and Jovian radiation yet provide adequate thermooptical and electrical resistance. Reference is made to the ESA Ulysses spacecraft, which also used ITO protection on thermal control surfaces. **Author** 

N87-26936\*# Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.

DEVELOPMENT OF AN EMULATION-SIMULATION THERMAL CONTROL MODEL FOR SPACE STATION APPLICATION Semiannual Status Report

JAMES G. HARTLEY and GENE T. COLWELL Oct. 1986 63 p (Contract NAG1-551)

(NASA-CR-180312; NAS 1.26:180312) Avail: NTIS HC A04/MF A01 CSCL 22B

The orbiting space station being developed by NASA will have many thermal sources and sinks as well as requirements for the transport of thermal energy through large distances. The station is also expected to evolve over twenty or more years from an initial design. As the station evolves, thermal management will become more difficult. Thus, analysis techniques to evaluate the effects of changing various thermal loads and the methods utilized to control temperature distributions in the station are essential. Analysis techniques, including a user-friendly computer program, were developed which should prove useful to thermal designers and system analysts working on the space station. The program uses a data base and user input to compute costs, sizes, and power requirements for individual components and complete systems. User input consists of selecting mission parameters, selecting thermal acquisition configurations, transport systems and distances, and thermal rejection configurations. The capabilities of the program may be expanded by including additional thermal models as subroutines. Author

N87-27702\*# Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.

DEVELOPMENT OF AN EMULATION-SIMULATION THERMAL CONTROL MODEL FOR SPACE STATION APPLICATION Semiannual Status Report

GENE T. COLWELL and JAMES G. HARTLEY Jul. 1987 11 p (Contract NAG1-551) (NASA-CR-181221; NAS 1.26:181221) Avail: NTIS HC A02/MF A01 CSCI 22B

Many features were added to the Thermal Control System (TCS) program to increase its user-friendliness. Several apparent inconsistencies were identified. In some instances, these have led to modifications to the source programs. With the summary line-sizing information, the user can more readily compare the TCS program results with other available data. Two mathematical models were completed: one deals with sizing and analysis of bus heat exchangers and the other provides a means of analyzing a variety of heat pipe radiator designs. A generic heat pipe model was added to the TCS Analysis Program.

N87-29217# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

THE LIQUID DROPLET RADIATOR IN SPACE: A PARAMETRIC APPROACH M.S. Thesis

GERALD L. BUCKNER Mar. 1987 72 p

(AD-A182605; AFIT/GNE/ENP/87M-1) Avail: NTIS HC A04/MF A01 CSCL 12B

A successful space mission must have a source of electrical power whether the mission is manned, unmanned, scientific, or nationally strategic. The generation of this electric power will require the rejection of waste heat. For example, the Strategic Defense Initiative will have space based systems generating large amounts of electrical energy with much waste heat energy to be radiated to space. Other space applications requiring from 100 kilowatts to over 100 megawatts include: Space Based Radars, Nuclear/Electric Orbital Transfer Vehicles, Space Based Weapon Systems, and the Space Station. The objective of this study was to investigate the performance and operating characteristics of a cylindrical LDR for use in space by minimizing the mass per heat radiated as a function of the average droplet temperature at the collector using a new pump specific mass term defined as pump mass per liquid mass flow rate.

#### 05

# ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEMS

Includes description of analytical techniques and models, trade studies of technologies, subsystems, support strategies, and experiments for internal and external environmental control and protection, life support systems, human factors, life sciences and safety.

#### A87-32455

# PRELIMINARY EXPERIMENTAL STUDY ON THE OXYGEN SEPARATING AND CONCENTRATING SYSTEM FOR CELSS

SHUJI KANDA, HIROYUKI MATSUMURA, TAKATOSHI SHOJI (Kawasaki Heavy Industries, Ltd., Kobe, Japan), KEIJI NITTA, KOHJI OHTSUBO (National Aerospace Laboratory, Chofu, Japan) et al. IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 1337-1341.

A system which uses Salcomine (ethoxy salicylaldehyde ethylene diamine cobalt) to separate and concentrate the oxygen produced in a CELSS for the Space Station is described. The Salcomine absorbs the oxygen under normal temperatures (less than 40 C) and desorbs oxygen under temperatures higher than 80 C. The concept of CELSS is reviewed and a diagram of a CELSS is provided. The operation of the gas recycle system, which is utilized as a reservoir in the CELSS to compensate for the difference between the gas production and consumption, is examined. The ability of the Salcomine to absorb or desorb oxygen is evaluated for Salcomine alone and Salcomine in a canister. It is observed that the oxygen absorbing capacity of the Salcomine is about 4.0 percent for Salcomine alone and about 2.7 percent

for Salcomine in a canister. Diagrams of the proposed gas recycle system and oxygen separating and concentration system are presented.

#### A87-32457

### GAS AND WATER RECYCLING SYSTEM FOR IOC VIVARIUM EXPERIMENTS

KOJI OTSUBO, KEIJI NITTA, MITSUO OGUCHI, SIGERU HAYASHI, SHIGEKI HATAYAMA (National Aerospace Laboratory, Chofu, Japan) et al. IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 1349-1354. Research supported by the Japanese CELSS Research Group. refs

A design for a gas and water recycling system to support life science missions at the initial operational capability of the Space Station is proposed. The gas recycling subsystem is composed of: prefilters to remove harmful gas; canister units for CO2 and O2 gas content control; humidifiers; gas bottles; and a controller. The operation of the subsystem, which is to remove CO2 gas from the outlet air of the animal vivariums and to remove excessive O2 gas from the outlet air of the phytotron and algae cultivator, is described. The water recycling subsystem is to use a high polymer membrane filtration unit and a distiller to purify the water; the roles of the microfilter, ultrafilter, and reverse osmosis filters of the membrane filtration unit are examined. Diagrams of the two subsystems are provided.

#### A87-32458

### WATER RECYCLING SYSTEM USING THERMOPERVAPORATION METHOD

KATSUYA EBARA, HIDEAKI KUROKAWA, AKIRA YAMADA, YASUO KOSEKI (Hitachi, Ltd., Hitachi Research Laboratory, Japan), and AKIRA ASHIDA (Hitachi, Ltd., Space Systems Div., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 1355-1359. refs

A space station water recycling system is evaluated on the basis of fundamental experiments and simulated calculations of absorption-type thermopervaporation. The specific electric conductivity of the treated water was below 10 microS/cm, and the coefficient of permeation through the membrane was more than 1 kg/sq m day mm Hg. The optimum operating conditions for the recycling system are presented.

#### A87-32459

#### WATER RECYCLING FOR SPACE STATION

KENJI MITANI, AKIRA ASHIDA (Hitachi, Ltd., Space Systems Div., Tokyo, Japan), KATSUYA EBARA (Hitachi, Ltd., Hitachi Research Laboratory, Japan), and KEIJI NITTA (National Aerospace Laboratory, Chofu, Japan) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 1361-1364.

A system configuration, based on membrane-based technology, for water recycling in the Space Station is proposed to purify water wastes produced by both the crew and the facilities of life science experiments. A three-step filtration process consisting of prefiltration, ultrafiltration and reverse osmosis provides water for showers and the life science experiments. A portion of the permeate from the reverse osmosis process is further processed by a thermopervaporation membrane technique to provide potable water. Ground experimental equipment for the water recycling system for the IOC Japanese life science experiments is described.

#### A87-32544

# CONCEPT STUDY OF REGENERABLE CARBON DIOXIDE REMOVAL AND OXYGEN RECOVERY SYSTEM FOR THE SPACE STATION

K. OTSUJI, T. SAWADA (Mitsubishi Heavy Industries, Ltd., Nagoya Aircraft Works, Japan), S. SATOU, and M. MINEMOTO (Mitsubishi

Heavy Industries, Ltd., Takasago Technical Institute, Japan) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2 . Tokyo, AGNE Publishing, Inc., 1986, p. 2007-2016. refs

Results are presented from Japanese studies of technologies for an atmosphere regeneration system (ARS) for the Space Station. The choice is between solid amine systems with either ion exchange resin (IER) or an amine impregnated adsorbant (AIA). IER Systems contain amino radicals that ion exchanges HCO3(-) produced by CO2 and atmosheric moisture. AIA systems holding a polyethylene-resin, potassium-n-methyl alaninate or other amine directly adsorb CO2 from the air. In the IER, CO2 is desorbed by steam heating, while in the AIA, CO2 is desorbed by heating or vacuum sucking. Experimental versions of the two types of ARSs are described, along with data indicating a preferred steam cannister configuration, a greater CO2 absorbancy of the IER relative to the AIA system, and lower energy requirements with steam regeneration. The principles of the Bosch and Sabatier processes for oxygen recovery are reviewed, and test data which indicate areas requiring further development are identified.

M.S.K.

# A87-32632 COMPUTER SIMULATION OF ON-ORBIT MANNED MANEUVERING UNIT OPERATIONS

GARY M. STUART and KATHY D. GARCIA (Martin Marietta Corp., Bethesda, MD) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 13-16, 1986. 7 p. Previously announced in STAR as N87-12245. (SAE PAPER 861783)

Simulation of spacecraft on-orbit operations is discussed in reference to Martin Marietta's Space Operations Simulation laboratory's use of computer software models to drive a six-degree-of-freedom moving base carriage and two target gimbal systems. In particular, key simulation issues and related computer models associated with providing man-in-the-loop simulations of the Manned Maneuvering Unit (MMU) are addressed with special attention given to how effectively these models and motion systems simulated the MMU's actual on-orbit operations. The weightless effects of the environment require the development of entirely new devices for locomotion. Since the access to space is very limited, it is necessary to design, build, and test these new devices within the physical constraints of earth using simulators. The simulation method that is discussed here is the technique of using computer software models to drive a Moving Base Carriage (MBC) that is capable of providing simultaneous six-degree-of-freedom motions. This method, utilized at Martin Marietta's Space Operations Simulation (SOS) laboratory, provides the ability to simulate the operation of manned spacecraft, provides the pilot with proper three-dimensional visual cues, and allows training of on-orbit operations. The purpose here is to discuss significant MMU simulation issues, the related models that were developed in response to these issues and how effectively these models simlate the MMU's actual on-orbiter operations. Author

#### A87-33013

### A COMPARISON BETWEEN SPACE SUITED AND UNSUITED REACH ENVELOPES

J. H. STRAMLER (Northrop Services, Inc., Houston, TX) IN: Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volume 1 . Santa Monica, CA, Human Factors Society, 1986, p. 221-224.

A comparison was made for the reach capability of Shuttle space suit vs unsuited. Graphics were generated and reach envelope volumes computed. The space suit reduces the reach envelope volume from about 64 to 97 percent, depending on the type of envelope measured.

Author

#### A87-35600

#### WHEN THE DOCTOR IS 200 MILES AWAY

LES DORR, JR. Space World (ISSN 0038-6332), vol. X-3-279, March 1987, p. 33-36.

Severe medical problems which may be encountered by crewmembers during Space Station tours of duty are discussed, as are the capabilities planned for the Station Health Maintenance Facility (HMF). Heart muscles lose tone and mass during long periods in microgravity, and bones inexorably lose calcium in a demineralization process. An increasing frequency of humans spending long periods of time in space introduces the possibility of occurrence of acute illnesses such as cardiovascular problems or kidney stones precipitating from bone calcium suspended in the blood. A prototype HMF has a defibrillator, ECG, pulse oximeter, patient restraints, CRT readouts, an IV system capable of long-term use, and exercise apparatus to offset the deconditioning effects of long-term spaceflight. All the equipment will be amenable to use by astronauts with paramedic training.

# A87-38708\* Vigyan Research Associates, Inc., Hampton, Va. EFFECTS OF VARYING ENVIRONMENTAL PARAMETERS ON TRACE CONTAMINANT CONCENTRATIONS IN THE NASA SPACE STATION REFERENCE CONFIGURATION

DANA A. BREWER (Vigyan Research Associates, Inc., Hampton, VA) and JOHN B. HALL, JR. (NASA, Langley Research Center, Hampton, VA) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 57-66. refs (Contract NAS1-550; NAS1-17919) (SAE PAPER 860916)

An evaluation is made of the NASA Space Station Reference Configuration trace contaminant production and depletion level effects of CO2, O2, humidity, temperature, and pressure variations, on the basis of a computer model of the Reference Configuration's chemical reactions and physical processes as functions of time. The effects of changes in the initial concentrations of such contaminants as nonmethane hydrocarbons and nitrogen oxides are also examined, and these are found to result in more significant changes in the concentration levels of trace contaminants than pressure and humidity variations. O2 and CO2 changes are found to have negligible effects on trace contaminant concentrations.

0.0

#### A87-38712 Life Systems, Inc., Cleveland, Ohio.

A SPACE STATION UTILITY - STATIC FEED ELECTROLYZER
J. T. LARKINS, R. C. WAGNER, and M. L. GOPIKANTH (Life
Systems, Inc., Cleveland, OH) IN: Aerospace environmental
systems; Proceedings of the Sixteenth Intersociety Conference on
Environmental Systems, San Diego, CA, July 14-16, 1986.
Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p.
97-107. Research supported by Life Systems, Inc. and NASA.
refs
(SAE PAPER 860920)

The NASA Static Feed Electrolyzer (SFE), which will be used in the projected Space Station, has over the course of 18 years of development and testing refined its ancilliary components and control and monitoring instrumentation. Space Station uses for the SFE are anticipated in environmental control and life support, electrical power systems, EVA, and the propulsion and reboost system. The commonalities among these four systems' requirements are presently examined.

#### A87-38716

#### FOODS AND NUTRITION IN SPACE

PAUL C. RAMBAUT (NIH, National Cancer Institute, Bethesda, MD) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 141-149. refs (SAE PAPER 860926)

The present evaluation of manned space flight experience with nutritional effects on crew metabolism from Mercury to Mir indicates that low caloric intakes contributed in some measure to the biochemical and physiological changes observed in early flights, and that some deteriorative or adaptive processes accompanying space flight can affect nutritional requirements to the point where

intakes appropriate in ground conditions become suboptimal. Body mass declines and the elemental constituents of bone and muscle continue to be lost. The assumption that humans require a diet of great complexity is reexamined in light of experimental evidence that individuals can be kept on a simple nutrient source for many years without ill effects.

O.C.

**A87-38720\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

#### SPACE STATION FOOD SYSTEM

BEVERLY A. THURMOND (NASA, Johnson Space Center, Houston, TX), DOUGLAS J. GILLAN, MICHELE G. PERCHONOK (Lockheed Engineering and Management Services Co., Inc., Houston, TX), BETH A. MARCUS (Arthur D. Little, Inc., Cambridge, MA), and CHARLES T. BOURLAND (Technology, Inc., Houston, TX) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 179-183. refs (SAE PAPER 860930)

A team of engineers and food scientists from NASA, the aerospace industry, food companies, and academia are defining the Space Station Food System. The team identified the system requirements based on an analysis of past and current space food systems, food systems from isolated environment communities that resemble Space Station, and the projected Space Station parameters. The team is resolving conflicts among requirements through the use of trade-off analyses. The requirements will give rise to a set of specifications which, in turn, will be used to produce concepts. Concept verification will include testing of prototypes, both in 1-g and microgravity. The end-item specification provides an overall guide for assembling a functional food system for Space Station.

# A87-38729\* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala. SPACE STATION ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM DISTRIBUTION AND LOOP CLOSURE

WILLIAM R. HUMPHRIES, JAMES L. REUTER, and RICHARD G. SCHUNK (NASA, Marshall Space Flight Center, Huntsville, AL) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 285-296.

(SAE PAPER 860942)

The NASA Space Station's environmental control and life support system (ECLSS) encompasses functional elements concerned with temperature and humidity control, atmosphere control and supply, atmosphere revitalization, fire detection and suppression, water recovery and management, waste management, and EVA support. Attention is presently given to functional and physical module distributions of the ECLSS among these elements, with a view to resource requirements and safety implications. A strategy of physical distribution coupled with functional centralization is for the air revitalization and water reclamation systems. Also discussed is the degree of loop closure desirable in the initial operational capability status Space Station's oxygen and water reclamation loops.

A87-38730\* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

# STATUS OF THE SPACE STATION ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEM DESIGN CONCEPT

C. D. RAY and W. R. HUMPHRIES (NASA, Marshall Space Flight Center, Huntsville, AL) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 297-308.

(SAE PAPER 860943)

The current status of the Space Station (SS) environmental control and life support system (ECLSS) design is outlined. The

concept has been defined at the subsystem level. Data supporting these definitions are provided which identify general configurations for all modules. Requirements, guidelines and assumptions used in generating these configurations are detailed. The basic 2 US module 'core' Space Station is addressed along with system synergism issues and early man-tended and future growth considerations. Along with these basic studies, also addressed here are options related to variation in the 'core' module makeup and more austere Station concepts such as commonality, automation and design to cost.

# A87-38731\* Life Systems, Inc., Cleveland, Ohio. ENVIRONMENTAL CONTROL LIFE SUPPORT FOR THE SPACE STATION

CRAIG W. MILLER and LICIA S. KOVACH (Life Systems, Inc., Cleveland, OH) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 309-319. NASA-supported research.

(SAE PAPER 860944)

The preliminary design of the nation's Space Station is presently being developed. The Environmental Control and Life Support System (ECLSS), consisting of regenerative and nonregenerative technologies, has progressed through a series of trade studies including evaluation of the closure and distribution within the evolutionary Space Station configuration. The analysis has included the identification of the time-critical functions, redundancy (backup) management, definition of common subsystem interfaces and quantification of technology options for the process equipment. Each technology has been characterized by its physical characteristics of weight, power, volume, heat rejection, etc. Summaries of the trade study findings for the overall ECLSS in terms of physical characteristics and the impact of selected technologies is presented.

#### A87-38732

## NUCLEAR POWERED SUBMARINES AND THE SPACE STATION - A COMPARISON OF ECLSS REQUIREMENTS

ROBERT N. ROSSIER (Martin Marietta Corp., Denver, CO) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 321-329. (SAE PAPER 860945)

Both the NASA Space Station and current nuclear-powered submarines are required to sustain 90-day missions with their environmental control and life support systems (ECLSSs); their failure tolerance requirements are also similar. Detailed comparisons are presently undertaken for submarine and Space Station water, crew and power resources, pressurization requirements, shock and vibration environments, acoustics and noise considerations, external contamination prevention, and survivability. Subsystem design considerations encompass loop closure and the mass balance, reliability, CO2 removal and processing, oxygen generation, water recovery, atmospheric monitoring and contaminant control, waste management, and fire detection and suppression.

# A87-38733\* Life Systems, Inc., Cleveland, Ohio. INTEGRATED AIR REVITALIZATION SYSTEM FOR SPACE STATION

R. B. BOYDA, C. W. MILLER (Life Systems, Inc., Cleveland, OH), and M. R. SCHWARTZ (NASA, Ames Research Center, Moffett Field, CA) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 331-343. NASA-supported research.

(SAE PAPER 860946)

Fifty-one distinct functions are encompassed by the Space Station's Environmental Control and Life Support System; one exception to this noninteractivity of functions is the regenerative

air revitalization system that removes and reduces CO2 and generates O2. The integration of these interdependent functions, and of humidity control, into a single system furnishes opportunities for process simplification as well as for power, weight and volume requirement reductions by comparison with discrete subsystems. Attention is presently given to a system which quantifies these integration-related savings and identifies additional advantages that accrue to this integrating design method.

#### A87-38735

### EVALUATION OF REGENERATIVE PORTABLE LIFE SUPPORT SYSTEM OPTIONS

JOSEPH A. CIOCCA (Grumman Corp., Space Systems Div., Bethpage, NY) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 357-365. refs

(SAE PAPER 860948)

An evaluation is made of the prospects for nonventing regenerative processes for Space Station application, in order to address the prohibitively high transportation costs associated with consumables resupply and the unacceptable contamination levels created by water-sublimating heat rejection devices. These regenerative processes are sought in CO2 removal, humidity control, and heat rejection; specific capacities as well as weight, volumes and power allocations are quantified for each of these categories, and representative packaging geometries are arrived at. Process interactions, candidate regeneration techniques, and potential cost savings are discussed.

#### A87-38736

### SPACE STATION LIFE SUPPORT OXYGEN GENERATION BY SPE WATER ELECTROLYZER SYSTEMS

ALBERT C. ERICKSON and JAMES F. MCELROY (United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 367-373.

(SAE PAPER 860949)

Life support oxygen generation by water electrolysis is being considered for the Space Station program. On board oxygen generation from reclaimed water would be a major step toward closing the life support loop. An SPE electrolyzer, within which solid polymer membranes are the sole electrolyte, is a candidate for Space Station life support oxygen generation. The SPE electrolyzer, of the type currently qualified and in use for life support in nuclear submarines, has been modified for use in the zero gravity space environment. The proposed SPE electrolyzer configurations have addressed the difficulties of two phase separation and minimization of maintenance. Two variations of SPE electrolyzers are described. One for supplying oxygen and hydrogen at a few hundred psi for use within the space habitat, and one for supplying 3000 psi oxygen for the extravehicular mobility unit. Author

#### A87-38737

### SPACE SUIT REACH AND STRENGTH ENVELOPE CONSIDERATIONS

ROBERT J. GRAY (ILC Industries, Inc., ILC Dover, Frederica, DE) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 375-381. refs (SAE PAPER 860950)

Major difficulties exist in establishing a database for space-suited astronauts' reach and length; ideally, all such data should be obtained in a microgravity environment. Attention is presently given to the equipment and data presentation techniques formerly and currently used by NASA and the USAF in their human strength and reach capability researches. Future requirements for

more detailed determinations of pressure suit capabilities are assessed and practical steps for the implementation of such experimental efforts are recommended.

O.C.

#### A87-38738

#### DESIRABILITY OF ARMS-IN CAPABILITY IN SPACE SUITS

YVETTE M. BEGIAN (ILC Industries, Inc., ILC Dover, Frederica, DE) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 383-396. refs (SAE PAPER 860951)

Retracting one or both arms from a space suit's sleeves into its torso has been envisioned as a means to enhance a crewperson's performance during repeated extended duration extravehicular activity (EVA). The purpose of this paper is to present considerations germane to the incorporation of an arm/arms-in feature in a space suit. It assesses what can be done with one and two arms-in; it presents the expected impacts to the wearer and the suit; and it discusses the operational feasibility of employing arm/arms-in.

#### A87-38749

## LIFE SUPPORT SUBSYSTEM CONCEPTS FOR BOTANICAL EXPERIMENTS OF LONG DURATION

H. R. LOSER (MBB-ERNO Raumfahrttechnik GmbH, Bremen, West Germany) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 499-514. refs (SAE PAPER 860967)

For botanical experiments with durations of several months (Eureca Botany Facility and Columbus Gravitational Biology Facility) consumables like water, carbon dioxide, oxygen, phytotoxin-removal gas may contribute significantly to the weight of a Life Support Subsystem (LSS). Since the amount of such consumables has a significant influence on the optimum choice of the LSS, a literature survey has been performed to obtain realistic values which may be used for preliminary design purposes. Based on a comparison of the likely performance requirements of the LSS of orbital botanical facilities and the environmental control and life-support subsystem (ECLSS) of the carrier, various LSS concepts are discussed which interact to a varying degree with the ECLSS. Interaction means in this case that the ECLSS is used as a resource for the consumables needed by the LSS. Advantages and disadvantages of such interaction, in particular weight savings and technical complexity, are addressed.

#### A87-38750

### AN EVOLUTIONARY APPROACH TO THE DEVELOPMENT OF A CELSS BASED AIR REVITALIZATION SYSTEM

ROBIN C. HUTTENBACH, MARTIN L. PRATT (Nelson Space Services, Ltd., England), and CHRIS BUCKE (LH Bioprocessing, Ltd., England) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 515-530. refs (SAE PAPER 860968)

The NASA Space Station's three-man Initial Operating Configuration's various conventional Air Revitalization System alternatives are presently compared with a biologically based system, with a view to the practical engineering requirements of this radical alternative. While the proposed biological system does not offer advantages in overall equivalent weight, it establishes the basis for a totally safe system that combines air, water, and waste management functions. The hardware employed includes an algal bioreactor, which may constitute the developmental starting-point for the long-term development of a controlled ecological life support system.

A87-38752\* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

LIFE SCIENCES RESEARCH FACILITY AUTOMATION

REQUIREMENTS AND CONCEPTS FOR THE SPACE STATION DARYL N. RASMUSSEN (NASA, Ames Research Center, Moffett Field, CA) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986 . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 539-552. (SAE PAPER 860970)

An evaluation is made of the methods and preliminary results of a study on prospects for the automation of the NASA Space Station's Life Sciences Research Facility. In order to remain within current Space Station resource allocations, approximately 85 percent of planned life science experiment tasks must be automated; these tasks encompass specimen care and feeding, cage and instrument cleaning, data acquisition and control, sample analysis, waste management, instrument calibration, materials inventory and management, and janitorial work. Task automation will free crews for specimen manipulation, tissue sampling, data interpretation and communication with ground controllers, and experiment management.

#### A87-38753

# HABITABILITY ISSUES FOR THE SCIENCE LABORATORY MODULE

GORDON V. FOGLEMAN (General Electric Co., Fairfield, CT), JOHN M. RIGSBY (Grumman Aerospace Corp., Bethpage, NY), and ROBERT L. CURTIS IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 553-559.

(SAE PAPER 860971)

Attention is given to concepts for Space Station Science Laboratory Module control console layout, crew restraints, trash management, and emergency eye washes and showers, in light of experience obtained during the Skylab and Spacelab programs and with a view to the far greater experimental complexity, longer mission duration, and largely civilian (rather than professional astronaut) status of Space Station crews. Work environment color and decoration has been found to have a profound effect on crew moods, attitudes, and productivity. Also essential in view of Skylab and Spacelab experience is crew privacy, which ensures concentration in analytical thought tasks associated with research and/or operations of a critical nature.

# A87-38761\* Umpqua Research Co., Myrtle Creek, Ore. PRE- AND POST-TREATMENT TECHNIQUES FOR SPACECRAFT WATER RECOVERY

DAVID F. PUTNAM, GERALD V. COLOMBO (Umpqua Research Co., Myrtle Creek, OR), and CINDA CHULLEN (NASA, Johnson Space Center, Houston, TX) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 627-634. refs

(SAE PAPER 860982)

Distillation-based waste water pretreatment and recovered water posttreatment methods are proposed for the NASA Space Station. Laboratory investigation results are reported for two nonoxidizing urine pretreatment formulas (hexadecyl trimethyl ammonium bromide and Cu/Cr) which minimize the generation of volatile organics, thereby significantly reducing posttreatment requirements. Three posttreatment methods (multifiltration, reverse osmosis, and UV-assisted ozone oxidation) have been identified which appear promising for the removal of organic contaminants from recovered water.

O.C.

A87-38762\* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. RESULTS ON REUSE OF RECLAIMED SHOWER WATER CHARLES E. VEROSTKO, RAFAEL GARCIA, DUANE L. PIERSON (NASA, Johnson Space Center, Houston, TX), RICHARD P. REYSA (Boeing Aerospace Co., Houston, TX), and ROBERT IRBE (Northrop Services, Inc., Microbiology Dept., Houston, TX) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 635-643. refs (SAE PAPER 860983)

The Waste Water Recovery System that has been used in conjunction with a microgravity whole body shower to test a closed loop shower water reclamation system applicable to the NASA Space Station employs a Thermoelectric Integrated Hollow Fiber Membrane Evaporation Subsystem. Attention is given to the suitability of a Space Shuttle soap for such crew showers, the effects of shower water on the entire system, and the purification qualities of the recovered water. The chemical pretreatment of the shower water for microorganism control involved activated carbon, mixed ion exchange resin beds, and iodine bactericide dispensing units. The water was recycled five times, demonstrating the feasibility of reuse.

# A87-38763\* Bend Research, Inc., Oreg. A MEMBRANE-BASED SUBSYSTEM FOR VERY HIGH RECOVERIES OF SPACECRAFT WASTE WATERS

RODERICK J. RAY, SANDRA E. RETZLAFF, LYN RADKE-MITCHELL, DAVID D. NEWBOLD (Bend Research, Inc., OR), and DONALD F. PRICE (NASA, Johnson Space Center, Houston, TX) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 645-659. refs (SAE PAPER 860984)

This paper describes the continued development of a membrane-based subsystem designed to recover up to 99.5 percent of the water from various spacecraft waste waters. Specifically discussed are: (1) the design and fabrication of an energy-efficient reverse-osmosis (RO) breadboard subsystem; (2) data showing the performance of this subsystem when operated on a synthetic wash-water solution - including the results of a 92-day test; and (3) the results of pasteurization studies, including the design and operation of an in-line pasteurizer. Also included in this paper is a discussion of the design and performance of a second RO stage. This second stage results in higher-purity product water at a minimal energy requirement and provides a substantial redundancy factor to this subsystem.

# A87-38764\* Chamberlain Mfg. Corp., Waterloo, Iowa. DEVELOPMENT OF A WATER RECOVERY SUBSYSTEM BASED ON VAPOR PHASE CATALYTIC AMMONIA REMOVAL (VPCAR)

P. BUDÍNINKAS, F. RASOULI (Chamberlain Manufacturing, Inc., GARD Div., Niles, IL), and T. WYDEVEN (NASA, Ames Research Center, Moffett Field, CA) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 661-667. refs (Contract NAS2-11687)

(SAE PAPER 860985)

An integrated engineering breadboard subsystem for the recovery of potable water from untreated urine was designed, fabricated and tested. It was fabricated from commercially available components without emphasis on weight, volume and power requirement optimization. Optimizing these parameters would make this process competitive with other spacecraft water recovery systems. Unlike other phase change systems, this process is based on the catalytic oxidation at elevated temperatures of ammonia and volatile hydrocarbons to innocuous products; therefore, no urine pretreatment is required. The testing program consisted of parametric tests, one month of daily tests, and a continuous run of 165 hours. The recovered water is low in ammonia, hydrocarbons and conductivity and requires only adjustment of its pH to meet drinking water standards.

#### A87-38765

### PHASE CHANGE WATER RECOVERY FOR SPACE STATION - PARAMETRIC TESTING AND ANALYSIS

ED M. ZDANKIEWICZ and JAMES CHU (Life Systems, Inc., Cleveland, OH) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 669-679.

(SAE PAPER 860986)

A parametric testing and a hardware improvement program have been conducted by NASA for a Vapor Compression Distillation Subsystem (VCDS) applicable to the Space Station for phase change recovery of potable water from waste water. This VCDS was designed to reclaim 95 percent of the available waste water at a nominal water recovery rate of 1.36 kg/hr and 308 K condenser temperature; a 300-percent improvement in water production rate, however, with a correspondingly lower specific energy, was achieved following incorporation of several improvements. O.C.

A87-38766\* AiResearch Mfg. Co., Torrance, Calif.
AIR EVAPORATION CLOSED CYCLE WATER RECOVERY
TECHNOLOGY - ADVANCED ENERGY SAVING DESIGNS

GWYNDOLYN MORASKO (AiResearch Manufacturing Co., Torrance, CA), DAVID F. PUTNAM (Umpqua Research Co., Myrtle Creek, OR), and ROBERT BAGDIGIAN (NASA, Marshall Space Flight Center, Huntsville, AL) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 681-690.

(SAE PAPER 860987)

The Air Evaporation water recovery system is a visible candidate for Space Station application. A four-man Air Evaporation open cycle system has been successfully demonstrated for waste water recovery in manned chamber tests. The design improvements described in this paper greatly enhance the system operation and energy efficiency of the air evaporation process. A state-of-the-art wick feed design which results in reduced logistics requirements is presented. In addition, several design concepts that incorporate regenerative features to minimize the energy input to the system are discussed. These include a recuperative heat exchanger, a heat pump for energy transfer to the air heater, and solar collectors for evaporative heat. The addition of the energy recovery devices will result in an energy reduction of more than 80 percent over the systems used in earlier manned chamber tests.

A87-38770\* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. SUPERCRITICAL WATER OXIDATION - CONCEPT ANALYSIS

FOR EVOLUTIONARY SPACE STATION APPLICATION
JOHN B. HALL, JR. (NASA, Langley Research Center, Hampton,
VA) and DANA A. BREWER (Vigyan Research Associates, Inc.,
Hampton, VA) IN: Aerospace environmental systems; Proceedings
of the Sixteenth Intersociety Conference on Environmental
Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA,
Society of Automotive Engineers, Inc., 1986, p. 733-745. refs
(Contract NAS1-17919)

(SAE PAPER 860993)

The ability of a supercritical water oxidation (SCWO) concept to reduce the number of processes needed in an evolutionary Space Station design's Environmental Control and Life Support System (ECLSS), while reducing resupply requirements and enhancing the integration of separate ECLSS functions into a single Supercritical Water Oxidation process, is evaluated. While not feasible for an initial operational capability Space Station, the SCWO's application to the evolutionary Space Station configuration would aid the integration of eight ECLSS functions into a single one, thereby significantly reducing program costs.

O.C.

A87-38771\* Life Systems, Inc., Cleveland, Ohio.
ENVIRONMENTAL CONTROL AND LIFE SUPPORT
TECHNOLOGIES FOR ADVANCED MANNED SPACE MISSIONS

F. T. POWELL, R. A. WYNVEEN (Life Systems, Inc., Cleveland, OH), and C. LIN (NASA, Johnson Space Center, Houston, TX) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 747-759. refs (SAE PAPER 860994)

Regenerative environmental control and life support system (ECLSS) technologies are found by the present evaluation to have reached a degree of maturity that recommends their application to long duration manned missions. The missions for which regenerative ECLSSs are attractive in virtue of the need to avoid expendables and resupply requirements have been identified as that of the long duration LEO Space Station, long duration stays at GEO, a permanently manned lunar base (or colony), manned platforms located at the earth-moon libration points L4 or L5, a Mars mission, deep space exploration, and asteroid exploration. A comparison is made between nonregenerative and regenerative ECLSSs in the cases of 10 essential functions.

**A87-38772\*** Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.

## AN ADVANCED CARBON REACTOR SUBSYSTEM FOR CARBON DIOXIDE REDUCTION

GARY P. NOYES (United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT) and ROBERT J. CUSICK (NASA, Johnson Space Center, Houston, TX) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 761-768. refs

(SAE PAPER 860995)

An evaluation is presented of the development status of an advanced carbon-reactor subsystem (ACRS) for the production of water and dense, solid carbon from CO2 and hydrogen, as required in physiochemical air revitalization systems for long-duration manned space missions. The ACRS consists of a Sabatier Methanation Reactor (SMR) that reduces CO2 with hydrogen to form methane and water, a gas-liquid separator to remove product water from the methane, and a Carbon Formation Reactor (CFR) to pyrolize methane to carbon and hydrogen; the carbon is recycled to the SMR, while the produce carbon is periodically removed from the CFR. A preprototype ACRS under development for the NASA Space Station is described.

A87-38773\* General Electric Co., Houston, Tex.

INTEGRATED WASTE AND WATER MANAGEMENT SYSTEM

R. W. MURRAY (General Electric Co., Houston, TX) and R. L. SAUER (NASA, Johnson Space Center, Houston, TX) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 769-774.

(SAE PAPER 860996)

The performance requirements of the NASA Space Station have prompted a reexamination of a previously developed integrated waste and water management system that used distillation and catalytic oxydation to purify waste water, and microbial digestion and incineration for waste solids disposal. This system successfully operated continuously for 206 days, for a 4-man equivalent load of urine, feces, wash water, condensate, and trash. Attention is given to synergisms that could be established with other life support systems, in the cases of thermal integration, design commonality, and novel technologies.

O.C.

#### A87-38774

#### CELSS WASTE MANAGEMENT SYSTEMS EVALUATION

THOMAS J. SLAVIN, FREDERICK A. LIENING, and MELVIN W. OLESON (Boeing Aerospace Co., Space Systems Div., Seattle, WA) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986 . Warrendale, PA, Society of

Automotive Engineers, Inc., 1986, p. 775-790. refs (SAE PAPER 860997)

This report compares parametric data for the following six waste management subsystems, as considered for use on the Space Station: (1) dry incineration, (2) wet oxidation, (3) supercritical water oxidation, (4) vapor compression distillation, (5) a thermoelectric integrated membrane evaporation system, and (6) vapor phase catalytic ammonia removal. The parameters selected for comparison are on-orbit weight and volume, resupply and return to earth logistics, power consumption, and heat rejection. The six waste treatment subsystems modeled in this program are sized to process the wastes for a 90-day Space Station mission with a crew of eight persons and an emergency supply period of 28 days.

#### A87-38779

# CONTROL/MONITOR INSTRUMENTATION FOR ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEMS ABOARD THE SPACE STATION

DENNIS B. HEPPNER, JIM M. KHOURY, and JIM D. POWELL (Life Systems, Inc., Cleveland, OH) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 835-844.

(SAE PAPER 861007)

Automatic monitoring and control of the NASA Space Station's subsystems operation in order to free crews for scientific experiments will involve real time data processing, subsystem fault tolerance and redundancy management, caution and warning, health monitoring and trend analysis, data management, and support for on-orbit maintenance and repair. Attention is presently given to the Environmental Control and Life Support System's automation requirements, detailing sensor and actuator requirements and the controller's hierarchy design. The evolutionary development of a family of controllers for autonomous operation at both the prototype and flight production levels is also discussed.

#### A87-41666

# DYNAMIC BEHAVIOR OF ASTRONAUTS AND SATELLITES OUTSIDE AN ORBITING SPACE STATION UNDER THE INFLUENCE OF THRUST

H. F. BAUER (Muenchen, Universitaet der Bundeswehr, Neubiberg, West Germany) Zeitschrift fuer Flugwissenschaften und Weltraumforschung (ISSN 0342-068X), vol. 11, Jan.-Feb. 1987, p. 12-18.

The motion trajectories of astronauts during space walks or of satellites when outside a space station under the action of a constant thrust are determined with and without the effect of mass change during the thrusting period. Different magnitudes and directions of thrust application are investigated.

Author

#### A87-43122#

### EXTERNAL CONTAMINATION ENVIRONMENT OF SPACE STATION CUSTOMER SERVICING FACILITY

MICHAEL C. FONG, ALECK L. LEE, and PAUL T. MA (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) AIAA, Thermophysics Conference, 22nd, Honolulu, HI, June 8-10, 1987. 11 p. refs (AIAA PAPER 87-1623)

The paper discusses the results of an analytical study to define the on-orbit external contamination environment of the Space Station (SS) Customer Servicing Facility (CSF). The topics included in this paper are: (1) molecular contaminant transport from outgassing sources to the CSF interior and other SS surfaces due to direct or reflected/reevaporated molecular fluxes as well as intermolecular collisions, (2) orbiter reaction control system plume contamination during proximity operations, and (3) particulate contaminant cloud environment of the CSF. Sample predictions are based on a twin-keeled SS configuration with a typical large payload and assumed proximity operational scenarios. The maximum molecular contaminant flux (in terms of incident flux) on the CSF payload could be as high as 1.5 x 10 to the -6th g/sq

cm-sec due to direct/reflected/reevaporated fluxes and 10 to the -8th g/sq cm-sec due to molecular backscatter, the most severe source being moisture desorption from astronaut's suit during extravehicular activity.

# A87-53979\* Vigyan Research Associates, Inc., Hampton, Va. A SIMULATION MODEL FOR THE ANALYSIS OF SPACE STATION GAS-PHASE TRACE CONTAMINANTS

DANA A. BREWER (Vigyan Research Associates, Inc., Hampton, VA) and JOHN B. HALL, JR. (NASA, Langley Research Center, Hampton, VA) Acta Astronautica (ISSN 0094-5765), vol. 15, Aug. 1987, p. 527-543. refs (Contract NAS1-550; NAS1-17919)

A simulation model for the analysis of gas-phase trace contaminants in the cabin air of the NASA Space Station Reference Configuration was developed at the NASA Langley Research Center. The model predicts changes in trace contaminant concentrations from both physical and chemical sources and sinks as a function of time. Simulations were performed in which values for relative humidity, temperature, radiation intensity, pressure, and initial species concentrations were constrained to values for these parameters measured and modeled in the continental tropics at the earth's surface. Species concentrations simulated using the model compared favorably with concentrations in the continental tropics which demonstrated that the chemical mechanism in the trace contaminant model approximates changes in atmospheric species concentrations. The sensitivity of initial species concentrations to producing changes in additional species concentrations was also assessed. Results from the model indicated that chemical reactions will be important in determining the composition of cabin air in the Space Station. It is anticipated that the trace contaminant model will be useful in assessing the impact of experiments and commercial operations on the composition of the cabin air in the Space Station.

# N87-21155\*# Hamilton Standard, Windsor Locks, Conn. MAINTENANCE EVALUATION FOR SPACE STATION LIQUID SYSTEMS

CHARLES FLUGEL In NASA. Lewis Research Center Microgravity Fluid Management Symposium p 171-187 Apr. 1987 Avail: NTIS HC A10/MF A01 CSCL 22A

Many of the thermal and environmental control life support subsystems as well as other subsystems of the space station utilize various liquids and contain components which are either expendables or are life-limited in some way. Since the space station has a 20-year minimum orbital lifetime requirement, there will also be random failures occurring within the various liquid-containing subsystems. These factors as well as the planned space station build-up sequence require that maintenance concepts be developed prior to the design phase. This applies to the equipment which needs maintenance as well as the equipment which may be required at a maintenance work station within the space station. This paper presents several maintenance concepts for liquid-containing items and a flight experiment program which would allow for evaluation and improvement of these concepts so they can be incorporated in the space station designs at the outset of its design phase.

N87-24064\*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

#### HUMAN FACTORS IN SPACE STATION ARCHITECTURE 2. EVA ACCESS FACILITY: A COMPARATIVE ANALYSIS OF 4 CONCEPTS FOR ON-ORBIT SPACE SUIT SERVICING

MARC M. COHEN and STEVEN BUSSOLARI (Massachusetts Inst. of Tech., Cambridge.) Apr. 1987 25 p

(NASA-TM-86856; A-86037; NAS 1.15:86856) Avail: NTIS HC A02/MF A01 CSCL 05H

Four concepts for on-orbit spacesuit donning, doffing, servicing, check-out, egress and ingress are presented. These are: the Space Transportation System (STS) Type (shuttle system enlarged), the Transit Airlock (Shuttle Airlock with suit servicing removed from the pump-down chamber), the Suitport (a rear-entry suit mates to a port in the airlock wall), and the Crewlock (a small, individual,

conformal airlock). Each of these four concepts is compared through a series of seven steps representing a typical Extra Vehicular Activity (EVA) mission: (1) Predonning suit preparation; (2) Portable Life Support System (PLSS) preparation; (3) Suit Donning and Final Check; (4) Egress/Ingress; (5) Mid-EVA rest period; (6) Post-EVA Securing; (7) Non-Routine Maintenance. The different characteristics of each concept are articulated through this step-by-step approach. Recommendations concerning an for further evaluations of airlock geometry, anthropometrics, ergonomics, and functional efficiency are made. The key recommendation is that before any particular airlock can be designed, the full range of spacesuit servicing functions must be considered, including timelines that are most supportive of EVA human productivity.

N87-26086\*# Science and Engineering Associates, Inc., Englewood, Colo.

CONTAMINATION ASSESSMENT FOR OSSA SPACE STATION IOC PAYLOADS Final Report, 6 May - 24 Nov. 1986

S. CHINN, T. GORDON, and R. RANTANEN Aug. 1987 137 p (Contract NAS8-36102; NAG8-592)

(NASA-CR-4091; NAS 1.26:4091) Avail: NTIS HC A07/MF A01 CSCL 22B

The results are presented from a study for the Space Station Planners Group of the Office of Space Sciences and Applications. The objectives of the study are: (1) the development of contamination protection requirements for protection of Space Station attached payloads, serviced payloads and platforms; and (2) the determination of unknowns or major impacts requiring further assessment. The nature, sources, and quantitative properties of the external contaminants to be encountered on the Station are summarized. The OSSA payload contamination protection requirements provided by the payload program managers are reviewed and the level of contamination awareness among them is discussed. Preparation of revisions to the contamination protection requirements are detailed. The comparative impact of flying the Station at constant atmospheric density rather than constant altitude is assessed. The impact of the transverse boom configuration of the Station on contamination is also assessed. The contamination protection guidelines which OSSA should enforce during their development of payloads are summarized.

Author

N87-26703\*# Galveston Coll., Tex. Div. of Mathematics and Science.

EXPANSION OF SPACE STATION DIAGNOSTIC CAPABILITY TO INCLUDE SEROLOGICAL IDENTIFICATION OF VIRAL AND BACTERIAL INFECTIONS

KELLY E. HEJTMANCIK In NASA. Lyndon B. Johnson Space Center, National Aeronautics and Space Administration (NASA)/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1986, Volume 1 22 p Jun. 1987

Avail: NTIS HC A16/MF A01 CSCL 05A

It is necessary that an adequate microbiology capability be provided as part of the Health Maintenance Facility (HMF) to support expected microbial disease events during long periods of space flight. The applications of morphological and biochemical studies to confirm the presence of certain bacterial and fungal disease agents are currently available and under consideration. This confirmation would be greatly facilitated through employment of serological methods to aid in the identification for not only bacterial and fungal agents, but viruses as well. A number of serological approached were considered, particularly the use of Enzyme Linked Immunosorbent Assays (ELISAs), which could be utilized during space flight conditions. A solid phase, membrane supported ELISA for the detection of Bordetella pertussis was developed to show a potential model system that would meet the HMF requirements and specifications for the future space station. A second model system for the detection of Legionella pneumophilia, an expected bacterial disease agent, is currently under investigation. Author

N87-27392\*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

QUALITY REQUIREMENTS FOR RECLAIMED/RECYCLED WATER

DANIEL S. JANIK (National Academy of Sciences - National Research Council, Houston, Tex.), RICHARD L. SAUER, DUANE L. PIERSON, and YVONNE R. THORSTENSON Mar. 1987 35 p

(NASA-TM-58279; S-559; NAS 1.15:58279) Avail: NTIS HC A03/MF A01 CSCL 06K

Water used during current and previous space missions has been either carried or made aloft. Future human space endeavors will require some form of water reclamation and recycling. There is little experience in the U.S. space program with this technology. Water reclamation and recycling constitute engineering challenges of the broadest nature that will require an intensive research and development effort if this technology is to mature in time for practical use on the proposed U.S. Space Station. In order for this to happen, reclaimed/recycled water specifications will need to be devised to guide engineering development. Present NASA Potable Water Specifications are not applicable to reclaimed or recycled water. Adequate specifications for ensuring the quality of the reclaimed or recycled potable water system is reviewed, limitations of present water specifications are examined, world experience with potable water reclamation/recycling systems and systems analogs is reviewed, and an approach to developing pertinent biomedical water specifications for spacecraft is presented. Space Station water specifications should be designed to ensure the health of all likely spacecraft inhabitants including man, animals, and plants.

N87-27405\*# Texas Univ., Austin. Dept. of Psychology.
THE UNDERSEA HABITAT AS A SPACE STATION ANALOG:
EVALUATION OF RESEARCH AND TRAINING POTENTIAL
ROBERT L. HELMREICH and JOHN A. WILHELM 1 Oct. 1985
20 p

(Contract NCC2-286)

(NASA-CR-180342; NAS 1.26:180342) Avail: NTIS HC A02/MF A01 CSCL 05H

An evaluation is given of the utility of undersea habitats for both research and training on behavioral issues relative to the space station. The feasibility of a particular habitat, La Chalupa, is discussed.

Author

N87-27407\*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

SPACE SUIT EXTRAVEHICULAR HAZARDS PROTECTION DEVELOPMENT

JOSEPH J. KOSMO 14 Jan. 1987 32 p

(NASA-TM-89355; NAS 1.15:89355) Avail: NTIS HC A03/MF A01 CSCL 06K

Presented is an overview of the development of the integral thermal/micrometeoroid garment (ITMG) used for protection of a space-suited crewmember from hazards of various extravehicular environments. These hazard conditions can range from thermal extremes, meteoroid and debris particles, and radiation conditions in near-earth orbits and free space to sand and dust environments encountered on lunar or planetary surfaces. Representative ITMG materials cross-section layups are identified and described for various space-suit configurations ranging from the Gemini Program to planned protective requirements and considerations for anticipated Space Station EV operations.

N87-29117\*# Honeywell, Inc., Clearwater, Fla. Space and Strategic Avionics Div.

AUTOMATED SUBSYSTEM CONTROL FOR LIFE SUPPORT SYSTEM (ASCLSS) Final Report

ROGER F. BLOCK 15 Jul. 1987 65 p

(Contract NAS9-16895)

(NASA-CR-172003; NAS 1.26:172003) Avail: NTIS HC A04/MF A01 CSCL 06K

The Automated Subsystem Control for Life Support Systems (ASCLSS) program has successfully developed and demonstrated

a generic approach to the automation and control of space station subsystems. The automation system features a hierarchical and distributed real-time control architecture which places maximum controls authority at the lowest or process control level which enhances system autonomy. The ASCLSS demonstration system pioneered many automation and control concepts currently being considered in the space station data management system (DMS). Heavy emphasis is placed on controls hardware and software commonality implemented in accepted standards. The approach demonstrates successfully the application of real-time process and accountability with the subsystem or process developer. The ASCLSS system completely automates a space station subsystem (air revitalization group of the ASCLSS) which moves the crew/operator into a role of supervisory control authority. The ASCLSS program developed over 50 lessons learned which will aide future space station developers in the area of automation and controls...

N87-29594\*# Boeing Aerospace Co., Kent, Wash. Flight Technology Group.

SPACE STATION PROPULSION-ECLSS INTERACTION STUDY Final Report

SCOTT M. BRENNAN 14 Feb. 1986 92 p

(Contract NAS3-23353)

(NASA-CR-175093; NAS 1.26:175093; D483-10060-1) Avail:

NTIS HC A05/MF A01 CSCL 21H

The benefits of the utilization of effluents of the Space Station Environmental Control and Life Support (ECLS) system are examined. Various ECLSS-propulsion system interaction options are evaluated and compared on the basis of weight, volume, and power requirements. Annual propulsive impulse to maintain station altitude during a complete solar cycle of eleven years and the effect on station resupply are considered.

#### 06

#### **DYNAMICS AND CONTROLS**

Includes descriptions of analytical techniques and computer codes, trade studies, requirements and descriptions of orbit maintenance systems, rigid and flexible body attitude sensing systems and controls such as momentum wheels and/or propulsive schemes.

# A87-31681\* Rice Univ., Houston, Tex. OPTIMAL TRAJECTORIES FOR AEROASSISTED, COPLANAR ORBITAL TRANSFER

A. MIELE (Rice University, Houston, TX), V. K. BASAPUR, and W. Y. LEE Journal of Optimization Theory and Applications (ISSN 0022-3239), vol. 52, Jan. 1987, p. 1-24. refs (Contract JPL-956415)

Classical and minimax optimal control problems arising in the study of aeroassisted coplanar orbit transfer from a high planetary orbit to a low one are considered. Attention is given to (1) the minimization of the energy required for the maneuver; (2) minimization of the time integral of the heating rate; (3) minimization of the time of flight during the atmospheric portion of the trajectory; (4) maximization of the time of flight during the atmospheric portion of the trajectory; (5) minimization of the time integral of the path inclination; and (6) minimization of the sum of the squares of the entry and exit path inclinations.

# A87-32117 CONTROL OPERATIONS IN ADVANCED AEROSPACE

WILLIAM R. GRAHAM (R&D Associates, Marina Del Rey, CA) (IFAC, Symposium on Control of Distributed Parameter Systems, Los Angeles, CA, June 30-July 2, 1986) IEEE Control Systems Magazine (ISSN 0272-1708), vol. 7, Feb. 1987, p. 3-8.

Distributed parameter control systems being studied by NASA for use in advanced aerospace systems are described. A 15 m

diam antenna that will be deployed in space from a 2 cu m box has 96 control cables for controlling the shape of the antenna. Appropriate near- and far-field tests are needed for tuning the shape of the antenna on-orbit. The Space Station will be dynamically stabilized, damped and pointed with a high degree of accuracy, performed to a high degree by automated systems that adapt to a growing structure. Self-diagnosis is also a necessary feature of future EVA equipment and telerobotics, the latter assuming greater importance in a Rover for exploring the surface of Mars. The concepts are being implemented in the X-29 forward swept wing aircraft, the electronics of the Hubble Space Telescope, and in studies of the national aerospaceplane.

# A87-32338 TRANSIENT DYNAMICS OF ORBITING FLEXIBLE STRUCTURAL MEMBERS

V. J. MODI and A. M. IBRAHIM (British Columbia, University, Vancouver, Canada) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 1. Tokyo, AGNE Publishing, Inc., 1986, p. 483-488.

(Contract NSERC-67-1547)

Using a relatively general formulation procedure, this paper reviews complex interactions between deployment, attitude dynamics, and flexural rigidity for configurations representing deployment of beam and tether type appendages. The results suggest substantial influence of the flexibility, deployment velocity, initial conditions, and appendage orientation on the response, and under critical combinations of parameters the system can become unstable. The information has relevance to the design of control systems for: (1) the next generation of communication satellites; (2) the Orbiter based experiments such as SAFE (Solar Array Flight Experiment), SCOLE (Structural Control Laboratory Experiment), STEP (Structural Technology Exeriment Program), and the NASA/CNR tethered subsatellite system; as well as (3) the evolutionary transient and postconstruction operational phases of the proposed Space Station.

#### A87-32440

#### LOCAL CONTROL FOR LARGE SPACE STRUCTURES

TAKASHI KIDA, ISAO YAMAGUCHI, and YOSHIAKI OHKAMI (National Aerospace Laboratory, Chofu, Japan) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 1231-1236. refs

This paper describes the decentralized local control of a class of large space structures consisting of multirigid bodies that are connected through hinges. The formulation and the controller design are performed for each subbody independently from other contiguous bodies. For a simple two-body system, connective stability bounds are obtained when the local controller is designed by the pole placement method and by cost optimization. Author

#### A87-32441

# A CONSIDERATION TO VIBRATION CONTROL FOR A LARGE SPACE STRUCTURES

ETSUJIRO SHIMEMURA (Waseda University, Tokyo, Japan), TERUO FUJIWARA, TADASHI ADACHI, HIDEHIKO TAMAOKI, and SHINTARO KAWAGUCHI (Nissan Motor Co., Ltd., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 1237-1241.

The control problem of flexible space structures is one of the key technologies for the Space Station. This paper presents one approach to damp the vibration of the flexible structure using active control. The selection of the control method, modeling of the structure, and the control law are discussed. Computer simulation is performed to investigate the effects of control parameters. Numerical results show the improvement of the damping of the system and existence of the optimal point in control parameters.

Author

#### A87-32444

### VIBRATION CONTROL FOR A LINKED SYSTEM OF FLEXIBLE STRUCTURES

TOSHIO FUKUDA (Tokyo University of Science, Japan) and MASAHIRO ISOGAI IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 1255-1260. refs

A vibration control is proposed for a linked flexible system by allocating actuators at the joint of the linkage between the adjacent flexible structure and controlling these actuators, so that the coupled vibrations should be decreased. In order to derive the dynamics of such a linked system, first a flexible structure with the rigid bodies at each end is modeled by the bending vibration equation. Then, a decoupled control is shown based on these dynamics. In the experiments simulating the two-dimensional space environment, each joint at which flexible structures are supported is floated by air, so that there is no friction force from the ground to the floating joint and vice versa. Some experimental results are shown to demonstrate the effect of the proposed method.

Author

#### A87-32446

#### PRECISE POINTING CONTROL OF FLEXIBLE SPACECRAFT

TOSHIO KASHIWASE, MASAO INOUE, KATSUHIKO YAMADA, and KAZUO TSUCHIYA (Mitsubishi Electric Corp., Central Research Laboratory, Amagasaki, Japan) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 1267-1272.

A control system for the antenna pointing and the attitude control of the main body of a flexible communication satellite is proposed. The designing of the controller is described. The performance of the developed controller is evaluated experimentally. The experimental results are compared with numerical simulations of closed loop performances. Good correlation between the experimental and theoretical data is observed.

#### A87-32447

# A PRELIMINARY STUDY ON A LINEAR INERTIAL ACTUATOR FOR LSS CONTROL

TAKASHI KIDA, ISAO YAMAGUCHI, OSAMU OKAMOTO, YOSHIAKI OHKAMI (National Aerospace Laboratory, Chofu, Japan), YOSHIHARU SHIMAMOTO (Toshiba Corp., Research and Development Center, Kawasaki, Japan) et al. IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2 . Tokyo, AGNE Publishing, Inc., 1986, p. 1273-1278.

This paper describes some characteristics of a laboratory model of a linear inertial actuator developed for large space structure damping augmentation. The actuator has the capability of performing direct velocity feedback control to a class of large space structures, without causing control/observation spillover. A fundamental hardware experiment has been performed to demonstrate its capability and to clarify some basic aspects relating to hardware modeling.

#### A87-32448

# CONTROL OF FLEXIBLE SOLAR ARRAYS WITH CONSIDERATION OF THE ACTUATOR DYNAMICS OF THE REACTION WHEEL

TOSHIO FUKUDA, HIDEMI HOSOGAI (Tokyo University of Science, Japan), and NOBUYUKI YAJIMA (Ministry of International Trade and Industry, Mechanical Engineering Laboratory, Sakura, Japan) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 1279-1284. refs

This paper describes a control method to suppress such coupled vibrations and other interfering effects between a flexible solar array and a reaction wheel employed as an actuator. Based on the modal control, the dynamics of the overall system are obtained by taking into account the dynamics of the flexible array and the

dynamics of the reaction wheel. The vibration measurement is carried out by employing the differential solar cells, which can measure the deflection angles, and the vibrational modes can be estimated. The control performance is evaluated by the sums of the squares of both the actuator consumption energy and the strain gauge output. The settling time of the system is dependent on the size of the reaction wheel employed here.

Author

#### A87-32726

#### GUIDANCE AND CONTROL 1986; PROCEEDINGS OF THE ANNUAL ROCKY MOUNTAIN GUIDANCE AND CONTROL CONFERENCE, KEYSTONE, CO, FEB. 1-5, 1986

ROBERT D. CULP, ED. (Colorado, University, Boulder) and JOHN C. DURRETT, ED. (Martin Marietta Corp., Denver, CO) Conference sponsored by AAS. San Diego, CA, Univelt, Inc. , 1986, 459 p. For individual items see A87-32727 to A87-32751.

The development state of the art, and future designs of guidance and control systems for space applications are explored. The discussions cover control and pointing systems for large space structures such as the Space Station, passive damping and isolation techniques, and active vibration control for a Shuttle-based dynamic structural laboratory. Recent advances in control theory and in sensor, actuator and computational hardware and sophisticated quidance and control systems installed on the Galileo, Gamma Ray Observatory, Cosmic Background Explorer and Multi-Mission Modular Spacecraft are described. Conceptual designs and analyses being performed to support development of the Transfer Orbit Stage and the Orbital Maneuvering Vehicle are summarized. as are design features and test data from the SPACELAB Instrument Pointing System, the Solar Array Flight Dynamic Experiment, and Giotto guidance systems. Also, control systems and design features of telerobotic systems being studied as adjuncts to Shuttle and Space Station crew operations are discussed.

**A87-32727\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

# SYSTEM LEVEL VERIFICATION APPLYING THE SPACE SHUTTLE EXPERIENCE TO THE SPACE STATION

DAVID W. GILBERT (NASA, Johnson Space Center, Houston, TX) IN: Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986. San Diego, CA, Univelt, Inc., 1986, p. 3-10. (AAS PAPER 86-001)

The applicability of the verification process for the Shuttle guidance, navigation and control (GNC) and data management system (DMS) for the development of the Space Station are described. Shuttle avionics hardware/software integration was delayed to finalize the hardware design before detailed definition and testing of the software. A block diagram is provided of the flight simulation laboratory used to test the GNC programs before flight data were available. The Station will have distributed computers, unlike the Orbiter, and will only be assembled fully in space. Standardized integration simulation test equipment are being defined to guide the development of hardware and software. The simulation capability may become part of nominal in-flight operations to initiate new capabilities as they are added to the Station. The Station GNC and DMS systems development will be somewhat simplified relative to those of the Shuttle because ascent and reentry will not be considered for the Station.

#### A87-32730

# LOW-AUTHORITY CONTROL THROUGH PASSIVE DAMPING RUSSELL N. GEHLING (Martin Marietta Corp., Denver, CO) IN: Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986. San Diego, CA, Univelt, Inc., 1986, p. 51-69. refs (Contract F33615-82-C-3222) (AAS PAPER 86-004)

Results are presented from a study of active and passive damping application to the Representative System Article (RSA) developed under the Passive and Active Control of Space Structures (PACOSS) program of Martin Marietta. Three control

approaches are presented and demonstrated on a truncated model of the RSA. The approaches are active control alone via modal space control, passive damping alone, and low authority passive-active control. Results demonstrate that passive damping reduces the requirements for an active control system in terms of the number of control system components and the complexity of the control algorithm. This leads to simpler, more robust control systems which are likely to be more reliable and less expensive.

Jet Propulsion Lab., California Inst. of Tech., A87-32732\* Pasadena.

#### THE SOFTMOUNTED INERTIALLY REACTING POINTING SYSTEM (SIRPNT)

SAMUEL W. SIRLIN and ROBERT A. LASKIN (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 . San Diego, CA, Univelt, Inc., 1986, p. 85-105. refs (AAS PAPER 86-007)

A softmounted inertially reacting pointing system differs from traditional gimbal-based pointing system architecture in that: (1) the primary pointing control actuator does not need to apply torques on the basebody, and hence will not interact in a destabilizing way with basebody flexibility, and (2) the connection of the payload with the basebody is via a soft, low frequency structure, which acts as a two-way low pass filter for disturbances. Planar, linear analysis of a preliminary design of such a pointing system using the piezoelectric polymer material PVF2 as an active element in the softmount is presented demonstrating the potential performance in disturbance rich environments such as Space Station.

A87-32736\* Fairchild Space and Electronics Co., Germantown,

#### SPACE INFRARED TELESCOPE FACILITY/MULTIMISSION MODULAR SPACECRAFT ATTITUDE CONTROL SYSTEM CONCEPTUAL DESIGN

BRIAN F. CLASS, RAYMOND V. WELCH (Fairchild Space Co., Germantown, MD), FRANK H. BAUER (NASA, Goddard Space Flight Center, Greenbelt, MD), and KIM STROHBEHN (Johns Hopkins University, Laurel, MD) IN: Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 . San Diego, CA, Univelt, Inc., 1986, p. 155-175. refs (AAS PAPER 86-031)

A control system utilizing the Multi-mission Modular Spacecraft (MMS) Attitude Control System (ACS) was developed and analyzed for the Space Infrared Telescope Facility (SIRTF) spacecraft. Alternative torquer augmentation schemes were studied to determine viable ACS approaches. A control law was developed to use a dual set of single-axis Control Moment Gyros (CMGs) for two-axis control. Flexible structural models were developed using a high fidelity, flight tested NASTRAN model of the MMS, coupled with a NASTRAN model of the SIRTF telescope. Modal significance criteria were employed to reduce the structural model. Multivariable interactive techniques were used to synthesize the control system (including the structural filters). Control system performance for the SIRTF operational modes (quiescent inertial hold, slewing, nodding, and rastering) was then determined using both single-axis and three-axis simulations). The control system described met performance requirements for all modes but the raster with the use of CMGs. The raster performance was limited by the structural flexibility.

#### A HIGHLY ADAPTABLE STEERING/SELECTION PROCEDURE FOR COMBINED CMG/RCS SPACECRAFT CONTROL

JOSEPH A. PARADISO (Charles Stark Draper Laboratory, Inc., Cambridge, MA) IN: Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 . San Diego, CA, Univelt, Inc., 1986, p. 263-282. Research supported by Charles Stark Draper Laboratory, Inc. refs (AAS PAPER 86-036)

Attitude control laws are presented which will permit coordinated operation of control moment gyroscopes (CMG) and reaction control systems (RCS) on the Space Station. Emphasis was placed on defining a flexible CMG steering algorithm. Control laws are defined for obtaining a set of gimbal rates to match the CMG torque to a specific value in coordination with RCS jet firing. A linear programming algorithm is provided for generating optimized decision variables for the CMG/RCS actuators to meet a desired vehicle rate of change. Penalty functions are formulated to guide the selection of actuator commands. RCS firing, to be limited to an impulse mode, will be restricted to conditions requiring translational motion and when the CMG cannot respond due to saturation. Results are provided from simulations of attitude control for the Space Station power tower concept.

#### A87-33573\*# California Univ., Los Angeles. CONTROL AUGMENTED STRUCTURAL SYNTHESIS WITH TRANSIENT RESPONSE CONSTRAINTS

R. A. MANNING and L. A. SCHMIT (California, University, Los Angeles) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987, Technical Papers. Part 1 . New York, American Institute of Aeronautics and Astronautics, 1987, p. 194-204. Research supported by General Motors Corp. refs (Contract NSG-1490)

(AIAA PAPER 87-0749)

An integrated approach to the optimum design of control augmented structural systems is presented in which structural variables and control variables are changed simultaneously during the design process. Constraints are imposed on peak transient dynamic displacements and accelerations, static displacements, natural frequencies, and control system effort. Side constraints imposed on structural member sizes and control system thresholds and actuator output forces insure the generation of physically meaningful designs. Example problems are presented which bring out the benefits of simultaneous treatment of both the structural design variables and the control design variables.

#### A87-33710# SENSITIVITY OF DISTRIBUTED STRUCTURES TO MODEL ORDER IN FEEDBACK CONTROL

LEONARD MEIROVITCH and MARK A. NORRIS (Virginia Polytechnic Institute and State University, Blacksburg) Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2B . New York, American Institute of Aeronautics and Astronautics, 1987, p. 578-587. refs (Contract AF-AFOSR-83-0017)

(AIAA PAPER 87-0900)

Feedback controls generated on the basis of a discretized model are applied to the actual distributed system, and the corresponding closed-loop poles are obtained. The sensitivity of the distributed system to feedback controls is studied by examining the incremental change in the closed-loop poles corresponding to a reduction in the order of the discretized model. In the second form of the sensitivity study, closed-loop poles are plotted as the order of the discretized model varies. From a numerical model it is shown that feedback controls designed on the basis of low-order discretized models induce instability in the actual distributed structure.

Virginia Polytechnic Inst. and State Univ., A87-33713\*#

Blacksburg. A COMPARISON OF ACTIVE VIBRATION CONTROL TECHNIQUES - OUTPUT FEEDBACK VS OPTIMAL CONTROL

ZORAN N. MARTINOVIC, RAPHAEL T. HAFTKA, WILLIAM L. HALLAUER, JR., and GEORGE C. SCHAMEL, II (Virginia Polytechnic Institute and State University, Blacksburg) Structures, Structural Dynamics and Materials Conference, 28th,

Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2B. New York, American Institute of Aeronautics and Astronautics, 1987, p. 610-621. refs (Contract NAG1-224) (AIAA PAPER 87-0904)

The paper presents analytical and experimental comparison of two control laws for a laboratory structure designed to simulate large space structures. The first control law is the standard linear quadratic law, which is optimal but requires model reduction for practical implementation. The second control law is a new simple direct feedback control law designed to minimize control forces while guaranteeing stability. The optimal control law was found to be only slightly better than the direct feedback law even in terms of the quadratic performance index. Moreover, the optimal control law provided almost no margin of stability for the unmodeled modes while the direct feedback law provided significant stability margins to all modes. The above results were verified experimentally using

A87-33714\*# Virginia Polytechnic Inst. and State Univ., Blacksburg.

a digital implementation of the control laws. Excellent agreement

between the analytical prediction and experimental measurements

ACCURACY OF DERIVATIVES OF CONTROL PERFORMANCE USING A REDUCED STRUCTURAL MODEL

CHRIS A. SANDRIDGE and RAPHAEL T. HAFTKA (Virginia Polytechnic Institute and State University, Blacksburg) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2B. New York, American Institute of Aeronautics and Astronautics, 1987, p. 622-628. refs (Contract NAG1-603)

(AIAA PAPER 87-0905)

was observed.

The sensitivity of control system performance to structural changes is calculated for a multi-span beam with direct-rate feedback vibration control. Reduced models based on the natural modes of the structure are formed and derivatives of the damping ratios of the closed-loop eigenvalues are calculated. The convergence of the derivatives of the damping ratios with increasing number of modes is shown to be slower than the convergence of the damping ratios themselves. In particular, in some cases the convergence of finite-element approximations to the derivatives is much faster than the convergence of the modal approximations. The results indicate that the use of reduced models based on natural vibration modes may be ill-advised for calculating the sensitivity of control system performance to changes in the controlled structure.

#### A87-33730# HIGH SPEED SIMULATION OF MULTI-FLEXIBLE-BODY SYSTEMS WITH LARGE ROTATIONS

R. E. JONES, T. W. MORSE, and W. C. RUSSELL (Boeing Aerospace Co., Seattle, WA) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2B. New York, American Institute of Aeronautics and Astronautics, 1987, p. 781-789. refs (AIAA PAPER 87-0930)

The paper describes a fast multi-flexible-body dynamics code that combines nonlinear rigid and linearized flexible mode formulations and is applicable to systems with moderate rotation rates and flexibilities. Large angular motions are handled by updating the flexible modes and restarting the integration of the equations of motion. Comparisons of numerical results and computation times with those of the DISCOS code are given.

Author

A87-33731\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

DYNAMIC AND ATTITUDE CONTROL CHARACTERISTICS OF AN INTERNATIONAL SPACE STATION

THOMAS R. SUTTER, PAUL A. COOPER, JOHN W. YOUNG (NASA, Langley Research Center, Hampton, VA), and DON K. MCCUTCHEN (NASA, Johnson Space Center, Houston, TX) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2B . New York, American Institute of Aeronautics and Astronautics, 1987, p. 790-799. (AIAA PAPER 87-0931)

The structural dynamic characteristics of the International Space Station (ISS), the interim reference configuration established for NASA's Space Station developmental program, are discussed, and a finite element model is described. Modes and frequencies of the station below 2.0 Hz are derived, and the dynamic response of the station is simulated for an external impulse load corresponding to a failed shuttle-docking maneuver. A three-axis attitude control system regulates the ISS orientation, with control moment gyros responding to attitude and attitude rate signals. No instabilities were found in the attitude control system.

# A87-33738# ADAPTIVE TRACKING OF DYNAMICAL MODEL BY UNCERTAIN NONLINEARIZABLE SPACECRAFT

J. M. SKOWRONSKI (Queensland, University, Brisbane, Australia) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2B. New York, American Institute of Aeronautics and Astronautics, 1987, p. 861-867. refs (AIAA PAPER 87-0940)

Model reference adaptive control (MRAC) extended to cover the nonlinearizable systems with several equilibria, is used to control a mechanical space structure. The structure is modelled in general terms as a hybrid system, i.e., assembly of rigid bodies and flexible appendages, with only estimated data on its own configuration. The structure should track in real, possibly stipulated time and with stipulated accuracy a rigid body model with a desired state space behavior. Closed form algorithms for the signal adaptive feedback controllers and adaptive laws are designed together with state predictors which provide the feedback information without having to solve the motion equations. All the above makes the on-board computer to work as a calculator. The technique used bases on Liapunov Design, but the Liapunov functions are well defined and used as intermediate steps only, without appearing in the result. Author

#### A87-36762

INTELLIGENT FLYWHEEL ENERGY STORAGE UNITS WITH ADDITIONAL FUNCTIONS FOR FUTURE SPACE STATIONS IN NEAR-EARTH ORBITS [INTELLIGENTE SCHWUNGRADENERGIESPEICHER MIT ZUSAETZLICHEN FUNKTIONEN FUER ZUKUENFTIGE RAUMSTATIONEN IN ERDNAHEN UMLAUFBAHNEN]

U. BICHLER (Teldix GmbH, Heidelberg, West Germany) IN: Yearbook 1986 I; DGLR, Annual Meeting, Munich, West Germany, Oct. 8-10, 1986, Reports . Bonn, Deutsche Gesellschaft fuer Luft-und Raumfahrt, 1986, p. 89-97. In German. BMFT-supported research. refs (DGLR PAPER 86-172)

An intelligent flywheel energy storage system is described which, in addition to providing energy to a space station during solar eclipses, performs additional vital functions. It can act as a correcting element for triaxial positioning and stabilization, as a voltage generator for the on-board electrical network, and as damper of structural vibrations in the station. The flywheel energy storage principle is explained, and the flywheel itself is described. The energy storage, the converter between mechanical and electrical energy, and the performance characteristics of the flywheel are addressed.

National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

SHUTTLE ORBIT FLIGHT CONTROL DESIGN LESSONS -**DIRECTION FOR SPACE STATION** 

KENNETH J. COX (NASA, Johnson Space Center, Houston, TX) and PHILIP D. HATTIS (Charles Stark Draper Laboratory, Inc., Cambridge, MA) IEEE, Proceedings (ISSN 0018-9219), vol. 75, March 1987, p. 336-355. refs (Contract NAS9-17560)

The Space Shuttle orbit flight control system, which operates during all exo-atmospheric flight phases, has successfully met operational requirements. Many design integration and operational issues that required resolution during development and testing provide an experience base that will benefit the development of future space systems, particularly the Space Station. To this end, the applicable Shuttle and Space Station hardware/software is reviewed with some perspective provided on how current design groundrules were derived and how issues that affected the Shuttle orbit control system design are a pathway for the Space Station. Some of the most significant lessons learned from the Shuttle are summarized, with a discussion of the effect of performance and design of hardware, including the data processing system on software structures and usage procedures. Crew interface issues and important results from man-in-the-loop tests are summarized. Problems resulting from trying to meet difficult orbital operational objectives, including some sophisticated payload operations are characterized. Several proposed Shuttle flight control design improvements, developed in response to some of the lessons learned so far, are identified. Potential application of the Shuttle design lessons and new control technologies to the Space Station are discussed.

#### A87-39644# THE DESIGN AND ANALYSIS OF PASSIVE DAMPING FOR **AEROSPACE SYSTEMS**

DERRICK W. JOHNSON, ROY IKEGAMI (Boeing Aerospace Co., Seattle, WA), and ERIC M. AUSTIN (CSA Engineering, Inc., Palo Alto, CA) AlAA, ASME, ASCE, and AHS, Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987. 11 p.

(Contract F33615-82-C-3226)

(AIAA PAPER 87-0891)

A study has been performed to investigate the use of viscoelastic passive damping technology to decrease the vibroacoustic response of avionics equipment in typical satellite systems. The Boeing Inertial Upper Stage (IUS) was selected as a baseline satellite system to demonstrate these techniques on an established aerospace vehicle with the associated design requirements. To serve as a developmental test bed for evaluation of various damping concepts and validation of the analytical design tools, a smaller component test article, representative of the IUS equipment support section, was fabricated. Using the experience gained from the component test article, damping treatments were designed for the IUS dynamic test vehicle using finite element modeling and the modal strain energy method. These treatments were then installed on the dynamic test vehicle and evaluated through acoustic noise testing. The results of this testing are given compared to previous undamped test results and preestablished goals. Discussions are included about the basis of the goals on system reliability and the impact of the damping treatments on **Author** system requirements.

#### A87-39958\*

#### VARIABLE STRUCTURE CONTROLLER DESIGN FOR SPACECRAFT NUTATION DAMPING

HEBERTT SIRA-RAMIREZ and THOMAS A. W. DWYER, III (Illinois, University, Urbana) IEEE Transactions on Automatic Control (ISSN 0018-9286), vol. AC-32, May 1987, p. 435-438. refs (Contract NAG1-436; NSF ECS-85-16445; N00014-84-C-0149)

Variable structure systems theory is used to design an automatic controller for active nutation damping in momentum biased stabilized spacecraft. Robust feedback stabilization of roll and yaw angular dynamics is achieved with prescribed qualitative characteristics which are totally independent of the spacecraft Author defining parameters.

#### A87-40074#

#### DEPLOYMENT DYNAMICS OF SPACE STRUCTURES

V. J. MODI (British Columbia, University, Vancouver, Canada) U.S. National Congress of Applied Mechanics, 10th, Austin, TX, June 16-20, 1986, Proceedings . New York, American Society of Mechanical Engineers, 1987, p. 403-413. refs (Contract NSERC-67-1547)

Computational techniques for analyzing the deployment of complex flexible space structures are described and demonstrated. The general formulation of Modi and Ibrahim (1984) is extended to account for membrane, shell, and tether appendages with viscous/structural damping and momentum/reaction wheels. The basic principles of this approach are explained, and results for three sample problems (local-vertical deployment of a beam, arbitrary-orientation deployment of a beam from the Shuttle Orbiter, and Shuttle deployment of a subsatellite on a 100-km tether) are presented graphically. The importance of deployment-dynamics analysis tools and data bases for the Space Station is indicated.

#### A87-40867# DYNAMICS OF A MULTIBODY SYSTEM WITH RELATIVE TRANSLATION ON CURVED, FLEXIBLE TRACKS

DECHANG LI (East China Institute of Technology, Nanjing, People's Republic of China) and PETER W. LIKINS (Lehigh University, Journal of Guidance, Control, and Dynamics Bethlehem, PA) (ISSN 0731-5090), vol. 10, May-June 1987, p. 299-306. refs

Previous generic formulations of equations of motion for multibody systems treat explicitly only special cases of interbody translation, such as unconstrained translation or translation constrained to a straight, rigid track or a rigid plane. But real, physical tracks are not always even nominally straight, and they are always somewhat flexible. In this paper, the previous formulations are extended to accommodate interbody translations that can be characterized nominally by a single scalar variable (such as distance traveled on a curved track or screw path) plus motions induced by small deformations of the track or guideway.

#### A87-40869#

#### **NEW TIME-DOMAIN IDENTIFICATION TECHNIQUE**

FANG-BO YEH and CIANN-DONG YANG (National Chen Kung Journal of Guidance, University, Taiwan, Republic of China) Control, and Dynamics (ISSN 0731-5090), vol. 10, May-June 1987,

The novel methodology presented for the identification of vibrating structure model parameters obtains mass, stiffness, and damping matrices corresponding to a lumped equivalent model of the tested structure directly from the impulse response data. The scheme requires only a simple manipulation of the impulse response data. A spring mass-damper system shows the high accuracy of the identification procedure even under conditions in which the number of sampling points is limited.

National Aeronautics and Space Administration. A87-41103\*# Lewis Research Center, Cleveland, Ohio.

### RESISTOJET CONTROL AND POWER FOR HIGH FREQUENCY

ROBERT P. GRUBER (NASA, Lewis Research Center, Cleveland, AIAA, DGLR, and JSASS, International Electric Propulsion Conference, 19th, Colorado Springs, CO, May 11-13, 1987. 34 p. Previously announced in STAR as N87-20477. refs (AIAA PAPER 87-0994)

operational on many geosynchronous Resistojets are communication satellites which all use dc power buses. Multipropellant resistojets were selected for the Initial Operating Capability (IOC) Space Station which will supply 208 V, 20 kHz power. This paper discusses resistojet heater temperature controllers and passive power regulation methods for ac power

systems. A simple passive power regulation method suitable for use with regulated sinusoidal or square wave power was designed and tested using the Space Station multipropellant resistojet. The breadboard delivered 20 kHz power to the resistojet heater. Cold start surge current limiting, a power efficiency of 95 percent, and power regulation of better than 2 percent were demonstrated with a two component, 500 W breadboard power controller having a mass of 0.6 kg.

#### A87-41617

# ATTITUDE CONTROL OF A SPACECRAFT USING AN EXTENDED SELF-ORGANIZING FUZZY LOGIC CONTROLLER

S. DALEY (Brunel University, Uxbridge, England) and K. F. GILL (Leeds University, England) Institution of Mechanical Engineers, Proceedings, Part C - Mechanical Engineering Science (ISSN 0263-7154), vol. 201, no. C2, 1987, p. 97-106. refs
A simple method for extending the range of sensitivity of the

A simple method for extending the range of sensitivity of the self-organizing fuzzy logic controller (SOC) is proposed. The performance of the resulting controller is studied through its application to the attitude control of a flexible satellite. It is found that the extended SOC can provide excellent control and also possess a high degree of robustness.

Author

#### A87-42505#

# RESPONSE BOUNDS FOR LINEAR UNDERDAMPED SYSTEMS K. H. YAE and D. J. INMAN (New York, State University, Buffalo) ASME, Transactions, Journal of Applied Mechanics (ISSN

0021-8936), vol. 54, June 1987, p. 419-423. refs (Contract NSF MEA-83-51807; AF-AFOSR-82-0242;

AF-AFOSR-85-0220)

(ASME PAPER 87-APM-34)

This paper examines simple bounds on the displacement response of linear oscillatory multiple degree of freedom systems. Both the free and steady state forced responses are considered. The effect of mode coupling due to viscous damping is examined. The bounds are derived and stated in terms of the physical parameters of the structure and its inputs. Simple examples are given to illustrate the bounds and to compare the bounds developed here with previously published results.

Author

A87-42655\* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

OPTICAL CORRELATOR USE AT JOHNSON SPACE CENTER RICHARD D. JUDAY (NASA, Johnson Space Center, Houston, TX)

IN: Hybrid image processing; Proceedings of the Meeting,

Orlando, FL, Apr. 1, 2, 1986 Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1986, p. 22-24.

For automation and robotics in the Space Station era, NASA's Johnson Space Center is pursuing several means of synthetic vision. The optical correlator is one such means. The deformable mirror device will form the basis of the first correlator in this project. In-house and contracted effort is being used. Initial in-house activities will concentrate on an impulse deconvolution technique and on a programmable retina for spatial remappings of an image prior to correlation. The retina will permit a form of edge extraction and other primitive operations. Additionally, it will be used as a research tool for assisting persons with low vision.

A87-42816\* National Aeronautics and Space Administration.
Goddard Space Flight Center, Greenbelt, Md.
ACTUATORS FOR ACTIVELY CONTROLLED SPACE

#### STRUCTURES

P. STUDER, R. SHARMA (NASA, Goddard Space Flight Center, Greenbelt, MD), and A. BAZ (Catholic University of America, Washington, DC) IN: Acquisition, tracking, and pointing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1987, p. 148-159. refs

A free-flying platform of about 4 x 17 m overall dimensions, carrying a variety of imaging and sounding payloads, calls for an intelligent structure with active dynamic control of structural resonances. The actuators for such a structure must be lightweight, require low power, and allow integration into the structure without

degradation of its integrity; the dc-to-100 Hz dynamic range required may entail several types of actuators, as is presently emphasized. Broadband damping of higher-order modes requires modeling of the structure with a distributed array of sensors and actuators.

വവ

A87-42817\* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

# SOFT MOUNTED MOMENTUM COMPENSATED POINTING SYSTEM FOR THE SPACE SHUTTLE ORBITER

SAMUEL W. SIRLIN and CHARLES E. BELL (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Acquisition, tracking, and pointing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1987, p. 160-173. DOD-sponsored research.

This paper describes a potential pointing and tracking system for the Space Shuttle with possible future application to Space Station. In order to accomplish high precision pointing and tracking (at rates up to 2 deg/s) in the expected disturbance environment. a high bandwidth gimbaled pointing system is required. A soft-mounted, momentum-compensated gimbal system is suggested for this role. A momentum-compensated system is inertially reacting, decoupling the control system dynamics from the basebody structural dynamics. This allows a soft isolation stage to be added between the basebody and the articulation stage, which attenuates high frequency disturbances. In this paper, three configurations are examined: a hard-mounted system, a passive soft-mounted system, and an active soft-mounted system. Analysis demonstrates that the soft-mounted systems have superior disturbance-rejection properties. The active soft mount allows reduction of the isolation stiffness to zero, and so obtains the highest level of performance.

**A87-46301\*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

# FLEXIBLE SYSTEM MODEL REDUCTION AND CONTROL SYSTEM DESIGN BASED UPON ACTUATOR AND SENSOR INFLUENCE FUNCTIONS

YEUNG YAM (California Institute of Technology, Jet Propulsion Laboratory, Pasadena), TIMOTHY L. JOHNSON (General Electric Co., Schenectady, NY), and JEFFREY H. LANG (MIT, Cambridge, MA) IEEE Transactions on Automatic Control (ISSN 0018-9286), vol. AC-32, July 1987, p. 573-582. Sponsorship: Research supported by the Lockheed Missiles—and Space Co. refs (Contract DAAG29-78-C-0020; AF-AFOSR-83-0318)

A model reduction technique based on aggregation with respect to sensor and actuator influence functions rather than modes is presented for large systems of coupled second-order differential equations. Perturbation expressions which can predict the effects of spillover on both the reduced-order plant model and the neglected plant model are derived. For the special case of collocated actuators and sensors, these expressions lead to the derivation of constraints on the controller gains that are, given the validity of the perturbation technique, sufficient to guarantee the stability of the closed-loop system. A case study demonstrates the derivation of stabilizing controllers based on the present technique. The use of control and observation synthesis in modifying the dimension of the reduced-order plant model is also discussed. A numerical example is provided for illustration.

Author

#### A87-47810#

# ROBUST MULTIVARIABLE CONTROL OF LARGE SPACE STRUCTURES USING POSITIVITY

G. L. SLATER (Cincinnati, University, OH) and M. D. MCLAREN Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 10, July-Aug. 1987, p. 393-400. Previously cited in issue 23, p. 3428, Accession no. A86-47925.

#### A87-47811#

#### DYNAMICS OF GYROELASTIC SPACECRAFT

G. M. T. D'ELEUTERIO and P. C. HUGHES (Toronto, University,

(Structures, Structural Dynamics, and Downsview, Canada) Materials Conference, 26th, Orlando, FL, Technical Papers. Part 2, p. 384-390) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 10, July-Aug. 1987, p. 401-405. Previously cited in issue 13, p. 1941, Accession no. A85-30365. refs (Contract NSERC-A-4183)

#### A87-48273\* Nevada Univ., Las Vegas. ROBUST NONLINEAR ATTITUDE CONTROL OF FLEXIBLE **SPACECRAFT**

SAHJENDRA N. SINGH (Nevada, University, Las Vegas) Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. AES-23, May 1987, p. 380-387. refs (Contract NAS1-17369)

This paper presents an approach to large-angle rotational maneuvers of a spacecraft-beam-tip body configuration based on nonlinear invertibility and linear feedback stabilization. A control law u sub d is derived for the decoupled control of attitude angles, lateral elastic deflections, slopes due to bending and angular deflection due to torsion at the tip of the beam using torquers and force actuators. For the stabilization of the elastic modes, a linear feedback control law u sub s is obtained based on a linearized model augmented with a servocompensator. Simulation results are presented to show that large slewing and elastic mode stabilization can be accomplished.

#### A87-50033

#### MODELING AND CONTROL OF TORSIONAL VIBRATIONS IN A FLEXIBLE STRUCTURE

TOSHIO FUKUDA, HIDEMI HOSOGAI (Tokyo, Science University, Japan), FUMIHITO ARAI, and NOBUYUKI YAJIMA (Ministry of International Trade and Industry, Mechanical Engineering Laboratory, Sakura, Japan) JSME International Journal (ISSN 0913-185X), vol. 30, June 1987, p. 976-981. refs

This paper describes a modeling method of torsional vibrations of flexible large space structures, such as solar battery arrays, and a control method based on this model. The torsional vibrations are modeled by taking into account the flexibility of the solar array and the inertial moments of the supporting rigid body, based on the unconstrained mode method. Employing this model of the flexible structure, the system and the observation equations of the dynamics can be derived in the form of a state representation after an n mode decomposition. The torsional vibrations can be measured by using a newly developed differential-type sensor, which consists of a pair of neighboring solar cells. A vibration control method is shown by the state feedback based on the dynamics. Some of the experimental results employing the Author proposed control method are also shown.

#### A87-50401

#### AIAA GUIDANCE, NAVIGATION AND CONTROL CONFERENCE, MONTEREY, CA, AUG. 17-19, 1987, **TECHNICAL PAPERS. VOLUMES 1 & 2**

Conference sponsored by AIAA. New York, American Institute of Aeronautics and Astronautics, 1987, p. Vol. 1, 829 p.; vol. 2, 676 p. For individual items see A87-50402 to A87-50570.

The conference presents papers on control system synthesis and analysis, differential games, control of large flexible space structures, integrated flight systems applications, and robotics for space applications. Other topics include the artificial intelligence design challenge, aircraft guidance and control in severe windshear, and missile estimation and guidance strategies. Consideration is also given to guidance and navigation for space applications, inertial instrumentation and system testing and geokinetics, missile nonlinear control and trajectory optimization, computer-aided control design, man-in-the-flight control loop, spacecraft attitude determination and control, and fault tolerant systems.

#### A87-50404#

#### CONSTRUCTION OF POSITIVE REAL COMPENSATION FOR LSS CONTROL

G. L. SLATER (Cincinnati, University, OH) and M. D. MCLAREN IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 1 . New York, American Institute of Aeronatuics and Astronautics, 1987, p. 19-24. USAF-supported research. refs (AIAA PAPER 87-2238)

A novel technique for the determination of positive real transfer matrices with desired eigenvalues is presented. The algorithm employs a gradient technique in an iterative manner to approach a set of desired closed-loop eigenvalues in a minimum norm fashion. The method was found to be successful for both a simple second order problem and a more complicated fourth order model of the DRAPER I structure.

#### A87-50413# LOW-AUTHORITY CONTROL OF LARGE SPACE STRUCTURES BY USING TENDON CONTROL SYSTEM

Y. MUROTSU, H. OKUBO (Osaka, University, Sakai, Japan), and F. TERUI IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1987, p. 90-98. refs (AIAA PAPER 87-2249)

This paper deals with the problem of controlling the vibrations of large space structures by the use of a newly conceived torque actuation device, i.e., a tendon control system. It consists of a pair of tension cables transmitting as control torque to the structure at the moment arm position. The purpose of the study is twofold; first, to establish the analytical framework for low-authority control synthesis, and, second, to validate the proposed concept through a hardware experiment. A nonlinear optimization approach is proposed for the design of the control gains and the moment arm placement. This approach is useful when the total number of the control devices is smaller than that of the critical vibrational modes and exact pole placement is not possible. A hardware experiment has been done successfully, which shows the fundamental feasibility of the active tendon control for a highly flexible beam. However, for its practical application, further studies are needed especially on the interactions between the dynamics of the tension Author cables and the flexible structure.

#### A87-50414# CONTROL OF DISTRIBUTED STRUCTURES WITH SMALL NONPROPORTIONAL DAMPING

L. MEIROVITCHT and M. A. NORRIS (Virginia Polytechnic Institute and State University, Blacksburg) IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1987, p. 99-105. refs (Contract F33615-86-C-3233)

(AIAA PAPER 87-2250)

Undamped distributed structures represent self-adjoint systems, admitting real eigenvalues and real orthogonal eigenfunctions. Control of self-adjoint systems can be carried out conveniently by modal control. Distributed structures with proportional damping possess the same eigenfunctions as the corresponding undamped structures, so that the same modal approach can be used in this case as well. Nonproportional damping tends to destroy the self-adjointness of the system, so that modal control is not as convenient as for undamped structures. If damping is relatively small, however, it is possible to base the control design on the self-adjoint system and still obtain satisfactory control Author performance.

#### A87-50415# THE CONTROL OF LINEAR DAMPERS FOR LARGE SPACE **STRUCTURES**

J. K. HAVILAND, T. W. LIM, W. D. PILKEY (Virginia, University, Charlottesville), and H. POLITANSKY IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1987, p. 106-116. USAF-supported research. refs

(AIAA PAPER 87-2251)

This paper addresses the problem of designing a control system

for a small laboratory model of a linear proof-mass damper for large space structures. Initially a linear control law was developed, however, it was shown that, although adequate damping could be achieved at high frequencies, very little damping could be obtained at frequencies of one Herz or less with the linear law, because the system had to be constrained to operate within the physical limits set by the stops which limit the motion of the proof-mass. Because of this, recent efforts have been concentrated on a limiting performance control law. In a preliminary study, the optimal response was calculated for a single degree-of-freedom model of a cantilever beam controlled by a proof-mass damper using the limiting-performance/minimum-time formulations. It was found that considerable damping could be achieved at low frequencies. Parameter identification was used to find a suboptimal feedback control law based on the limiting performance characteristics, this could be considered for a practical application of a limiting performance control.

# A87-50472# REDUCED-ORDER COMPENSATION - LQG REDUCTION VERSUS OPTIMAL PROJECTION

S. W. GREELEY and D. C. HYLAND (Harris Corp., Government Aerospace Systems Div., Melbourne, FL) IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1987, p. 605-616. refs (Contract F49620-84-C-0038) (AIAA PAPER 87-2388)

Six methods for design of reduced-order compensation, five LQG reduction techniques and the Optimal Projection theory as implemented with a simple homotropy solution algorithm, are compared using the problem posed by Enns (1984). Design results are obtained by the methods for 42 different design cases, and comparison is made with respect to closed-loop stability and transient response characteristics. Although two of the LQG-reduction methods are shown to offer distinctly superior performance, only the Optimal Projection method provided stable performance in all the cases considered.

**A87-50474\***# Virginia Polytechnic Inst. and State Univ., Blacksburg.

AN ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF OUTPUT FEEDBACK VS. LINEAR QUADRATIC REGULATOR ZORAN N. MARTINOVIC, GEORGE C. SCHAMEL. II. RAPHAE

ZORAN N. MARTINOVIC, GEORGE C. SCHAMEL, II, RAPHAEL T. HAFTKA, and WILLIAM L. HALLAUER, JR. (Virginia Polytechnic Institute and State University, Blacksburg) IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 1. New York, American Institute of Aeronautics and Astronautics, 1987, p. 628-638. refs (Contract NAG1-224) (AIAA PAPER 87-2390)

This paper presents analytical and experimental comparison of three control laws for a laboratory structure designed to simulate large space structures. The first control law is the standard time invariant linear quadratic regulator with state estimation, which requires model reduction for practical implementation. This model reduction is associated with the so-called spillover instability. Two new simple direct output feedback control laws guaranteeing stability are proposed. One minimizes the maximum control force. and the other minimizes the same quadratic performance index as the linear quadratic regulator. The three control laws are found to give comparable performance for the modes retained in the reduced model. However, the standard linear quadratic regulator with state estimation provides almost no margin of stability for the unmodeled modes, while the simpler direct feedback laws provide significant stability margins to all modes. The analytical results were verified experimentally using a digital implementation of the control laws. Good agreement between the analytical predictions and experimental measurements was observed. Author

A87-50475#
COMPARISON OF DIFFERENT ATTITUDE CONTROL
SCHEMES FOR LARGE COMMUNICATIONS SATELLITES

S. K. SINGH, B. N. AGRAWAL (INTELSAT, Washington, DC), and R. GRAN (Grumman Aerospace Corp., Bethpage, NY) IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 1 . New York, American Institute of Aeronautics and Astronautics, 1987, p. 639-646. refs (AIAA PAPER 87-2391)

A comparative study of the robustness of various spacecraft body attitude control systems with structural flexibility is presented in this paper. The control systems examined are: (1) 3-Reaction Wheels (2) Body-fixed momentum wheel with offset thrusters (3) Skewed body-fixed momentum wheels with two reaction wheels. For the size of large spacecraft considered in this paper, all these systems are shown to result in satisfactory performance. In order to exhibit their relative merits, the presence of severe structural interaction had to be introduced. Comparison was then made in terms of stability, which is affected by non-colocation of actuators and sensors. Performance borne out of the nonlinear simulation with both the large flexible spacecraft and dummy unstable interacting low structural mode is illustrated. This latter study shows that a system with single body-fixed momentum wheel along pitch axis and two reaction wheels oriented along roll and yaw axes, is the most robust.

# A87-50486# CONTROL/DYNAMICS SIMULATION FOR PRELIMINARY SPACE STATION DESIGN

PAUL BLELLOCH (SDRC, Inc., San Diego, CA) IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 1. New York, American Institute of Aeronautics and Astronautics, 1987, p. 766-772. refs (AIAA PAPER 87-2641)

A method for integrating linear control systems into a structural dynamic software module is presented. The method is in contrast to integrating a separte control software package and represents a structural analogy to control systems. The structural dynamnics software module is part of an integrated package used for preliminary design analysis of the Space Station. Examaples of PID attitude control and interaction with the control of a flexible manipulator arm are presented.

#### A87-50503#

## AN AI-BASED MODEL-ADAPTIVE APPROACH TO FLEXIBLE STRUCTURE CONTROL

S. HANAGUD, B. J. GLASS, and A. J. CALISE (Georgia Institute of Technology, Atlanta) IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 2. New York, American Institute of Aeronautics and Astronautics, 1987, p. 930-940. refs (Contract DAAG29-82-K-0094) (AIAA PAPER 87-2457)

An adaptive control technique for discontinuously time-varying structures is developed using model identification and parameter identification to replace controllers when large-scale discontinuous model changes occur. The controller model replacement (CMR) method, utilizing the AI techniques of heuristic search and object-oriented programming, is demonstrated for the test problem of controlling a beam for which boundary conditions change suddenly in time. A linear optimal output feedback approach is employed to design the controller, once a new model is identified. For SISO and MIMO test problems, the CMR method was found to follow the actual model more closely than a comparable explicit self-tuning regulator, yielding better stability and performance.

R.R.

A87-50505\*# National Aeronautics and Space Administration.
Langley Research Center, Hampton, Va.

### ON-LINE IDENTIFICATION AND ATTITUDE CONTROL FOR SCOLE

R. C. MONTGOMERY, J. SHENHAR, and J. P. WILLIAMS (NASA, Langley Research Center, Hampton, VA) IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 2. New York, American Institute

of Aeronautics and Astronautics, 1987, p. 950-958. refs (AIAA PAPER 87-2459)

This paper documents on-line linear least-square identification and attitude control of SCOLE, a laboratory apparatus representing an offset-feed antenna attached to the Space Shuttle. Identification is done autonomously by starting a slew maneuver in pitch or roll with reaction jets and observing the time history data of associated Euler angles when the jets are quiescent. Linear least-square analysis is used to select the parameters that best fit the output of an Autoregressive (AR) model to the data. The control effectiveness of the jets is determined in a subsequent test, again using linear least squares. The parameters so derived are used to design switching lines for time-optimal attitude control. This report describes the identification and control algorithms and the experimental apparatus and procedures used. Also, experimental data are presented that reflect the performance of the identification algorithms and the attitude control system.

National Aeronautics and Space Administration. A87-50531\*# Lyndon B. Johnson Space Center, Houston, Tex.

#### PROPOSED CMG MOMENTUM MANAGEMENT SCHEME FOR **SPACE STATION**

L. R. BISHOP, R. H. BISHOP (NASA, Johnson Space Flight Center, Houston, TX), and K. L. LINDSAY (Charles Stark Draper Laboratory, Inc., Houston, TX) IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 2 New York, American Institute of Aeronautics and Astronautics, 1987, p. 1229-1236. refs (Contract NAS9-17560)

(AIAA PAPER 87-2528)

A discrete control moment gyro (CMG) momentum management scheme (MMS) applicable to spacecraft with principal axes misalignments, such as the proposed NASA dual keel space station, is presented in this paper. The objective of the MMS is to minmize CMG angular momentum storage requirements for maintaining the space station near local vertical in the presence of environmental disturbances. It utilizes available environmental disturbances, namely gravity gradient torques, to minimize CMG momentum storage. The MMS is executed once per orbit and generates a commanded torque equilibrium attitude (TEA) time history which consists of a yaw, pitch and roll angle command profile. Although the algorithm is called only once per orbit to compute the TEA profile, the space station will maneuver several discrete times each orbit.

National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

#### ADAPTIVE MOMENTUM MANAGEMENT FOR THE DUAL KEEL SPACE STATION

M. HOPKINS (NASA, Marshall Space Flight Center, Huntsville, AL) and E. HAHN (Allied-Signal, Inc., Bendix Guidance Systems Div., Teterboro, NJ) IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1987, p. 1472-1480.

(Contract NAS8-36488)

(AIAA PAPER 87-2596)

The report discusses momentum management for a large space structure with the structure selected configuration being the Initial Orbital Configuration of the dual-keel Space Station. The external torques considered were gravity gradient and aerodynamic torques. The goal of the momentum management scheme developed is to remove the bias components of the external torques and center the cyclic components of the stored angular momentum. The scheme investigated is adaptive to uncertainties of the inertia tensor and requires only approximate knowledge of principal moments of inertia. Computational requirements are minimal and should present no implementation problem in a flight-type computer. The method proposed is shown to be effective in the presence of attitude control bandwidths as low as 0.01 radian/sec. Author

A87-50561\*# Illinois Univ., Urbana.

#### TRACKING AND POINTING MANEUVERS WITH SLEW-EXCITED DEFORMATION SHAPING

THOMAS A. W. DWYER, III (Illinois, University, Urbana) AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1987, p. 1503-1511. refs

(Contract NSF ECS-85-16445; NAG1-436; NAG1-613) (AIAA PAPER 87-2599)

It is shown in this paper how it is possible to shape the slew-excited structural response of a deformable vehicle undergoing agile attitude maneuvers, so that the required fully corrected slew torque profiles can be computed on-line in closed form, and with the same bandwidth as required for the rigid body This is accomplished by simultaneously applying maneuver-dependent structural force controls of progressively smaller amplitudes, at the cost of progressively higher signal processing complexity of slew torque and structural force command

A87-50562\*# McDonnell-Douglas Astronautics Co., Houston,

#### THE DYNAMICS AND CONTROL OF THE SPACE STATION **POLAR PLATFORM**

M. M. WAHBAH (McDonnell Douglas Astronautics Co., Houston, TX) and G. C. ANDERSEN (NASA, Goddard Space Flight Center; Lockheed Missiles and Space Co., Inc., Greenbelt, MD) AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 2 . New York, American Institute of Aeronautics and Astronautics, 1987, p. 1512-1527. refs

(AIAA PAPER 87-2600)

The Space Station polar platform will carry a variety of earth observation instruments for NASA and the National Oceanic and Atmospheric Administration. In this paper, the asymmetrical platform is modeled as three connected rigid bodies. A generalized angular momentum equation is employed to derive the rotational equations of motion. These equations are linearized and used for preliminary sizing of control devices using a classical control approach. Two control systems are considered to stabilize the platform and satisfy the pointing requirements. The first system is composed of a single variable-speed, double-gimbaled momentum wheel and the second consists of three-reaction wheels. The performance of each system is assessed using a linear optimal control approach.

#### GLOBAL TREATMENT OF ENERGY DISSIPATION EFFECTS FOR MULTIBODY SATELLITES

F. P. J. RIMROTT (Toronto, University, Canada) IUTAM/IFToMM Symposium on Dynamics of Multibody Systems, Udine, Italy, Sept. 16-20, 1985, Proceedings . Berlin and New York, Springer-Verlag, 1986, p. 213-225.

The attitude drift of a two-body gyrostat with viscous internal energy dissipation is investigated analytically, applying a global approach. The formulations for the platform and rotor of a dual spinner are given; the energy dissipation, spin-change allotment, and kinetics are explored in detail; and expressions for the attitude drift rate and attitude stability are obtained. It is recommended that, in the practical design of satellites for attitude stability, the rotor/platform energy-dissipation ratio be made less than 1 but greater than 0.

#### A87-52252\*# Akron Univ., Ohio. EFFECT OF NOZZLE GEOMETRY ON THE RESISTOJET **EXHAUST PLUME**

LORANELL BREYLEY, JOHN S. SERAFINI (Akron, University, OH), DAVID J. HOFFMAN, and LYNETTE M. ZANA (NASA, Lewis Research Center, Cleveland, OH) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 23rd, San Diego, CA, June 29-July 2, 1987, 10 p. refs

(Contract NAG3-637) (AIAA PAPER 87-2121)

Five nozzle configurations were used to study the effect of geometry on the plume structure of a resistojet exhausting into a vacuum. Mass flux data in the forward and back flux regions were obtained with a cryogenically cooled quartz crystal microbalance. The propellant used was CO2 at 300 K and a mass flow rate of 0.2 g/s. The data reveal that the percent of mass flow contained within half angles of 10, 30, and 40 deg varied by less than 12 percent from a standard 20 deg half-angle cone nozzle. K.K.

A87-52965\*# Virginia Polytechnic Inst. and State Univ., Blacksburg.

### EQUATIONS OF MOTION FOR MANEUVERING FLEXIBLE SPACECRAFT

L. MEIROVITCH and R. D. QUINN (Virginia Polytechnic Institute and State University, Blacksburg) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 10, Sept.-Oct. 1987, p. 453-465. refs (Contract NAG1-225)

This paper is concerned with the derivation of the equations of motion for maneuvering flexible spacecraft both in orbit and in an earth-based laboratory. The structure is assumed to undergo large rigid-body maneuvers and small elastic deformations. A perturbation approach is presented in which the quantities defining the rigid-body maneuver are regarded as the unperturbed motion and the elastic motions and deviations from the rigid-body motions are regarded as the perturbed motion. The perturbation equations are linear, non-self-adjoint, and with time-dependent coefficients. A maneuver force distribution exciting the least amount of elastic deformation of the spacecraft is developed. Numerical results highlight the vibration caused by rotational maneuvers.

# A87-52968# MASS PROPERTY ESTIMATION FOR CONTROL OF ASYMMETRICAL SATELLITES

E. V. BERGMANN (Charles Stark Draper Laboratory, Inc., Cambridge, MA), B. K. WALKER (Cincinnati, University, OH), and D. R. LEVY (USAF, Space Div., Los Angeles, CA) (Guidance, Navigation and Control Conference, Snowmass, CO, Aug. 19-21, 1985, Technical Papers, p. 83-93) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 10, Sept.-Oct. 1987, p. 483-491. Previously cited in issue 22, p. 3238, Accession no. A85-45886. refs

#### A87-52973#

### MODEL REFERENCE ADAPTIVE CONTROL FOR LARGE STRUCTURAL SYSTEMS

I. H. MUFTI (National Research Council of Canada, Ottawa) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 10, Sept.-Oct. 1987, p. 507-509.

The implicit model reference adaptive control technique is here applied to the case of collocated actuators. By constructing a suitable Liapunov function, it is shown that the ratio of position-to-rate output is limited by twice the product of the damping ratio and the lowest structural frequency. The control law is proposed in the form of integral, proportional, and relay adaptations along with the integral of the output error.

C.D.

# N87-20371# Martin Marietta Aerospace, Denver, Colo. BENEFITS OF PASSIVE DAMPING AS APPLIED TO ACTIVE CONTROL OF LARGE SPACE STRUCTURES

R. N. GEHLING, H. W. HARCROW, and G. MOROSOW In AGARD Mechanical Qualification of Large Flexible Spacecraft Structures 8 p Jul. 1986
Avail: NTIS HC A12/MF A01

Active vibration and shape control of large space structures (LSS) has received a great deal of attention recently, while passive damping measures have been somewhat neglected. However, benefits may be derived from simultaneously considering both passive and active control measures to achieve certain performance requirements. Presented are results of a preliminary study of the role passive damping plays in the design and

performance of active vibration control strategies. Passive dampers were incorporated into a representative LSS and their effect on candidate active control laws was investigated. Viscous dampers were implemented in time simulations with direct velocity feedback and optimal quadratic regulator control laws. The impact of passive damping on overall closed-loop performance, control system spill-over and robustness, and active control requirements was evaluated. Numerical results are presented for a representative model. The merit of designing a LSS to incorporate discrete passive dampers in the overall approach to vibration suppression is demonstrated through a reduction in demands placed upon an active control system.

N87-20380\*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

### SOLAR ARRAY FLIGHT EXPERIMENT/DYNAMIC AUGMENTATION EXPERIMENT

CSCL 10A

LEIGHTON E. YOUNG and HOMER C. PACK, JR. Feb. 1987 72 p (NASA-TP-2690; NAS 1.60:2690) Avail: NTIS HC A04/MF A01

This report presents the objectives, design, testing, and data analyses of the Solar Array Flight Experiment/Dynamic Augmentation Experiment (SAFE/DAE) that was tested aboard Shuttle in September 1984. The SAFE was a lightweight, flat-fold array that employed a thin polyimide film (Kapton) as a substrate for the solar cells. Extension/retraction, dynamics, electrical and thermal tests, were performed. Of particular interest is the dynamic behavior of such a large lightweight structure in space. Three techniques for measuring and analyzing this behavior were employed. The methodology for performing these tests, gathering data, and data analyses are presented. The report shows that the SAFE solar array technology is ready for application and that new methods are available to assess the dynamics of large structures in space.

N87-20477\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

### RESISTOJET CONTROL AND POWER FOR HIGH FREQUENCY AC BUSES

ROBERT P. GRUBER 1987 33 p Presented at the 19th International Electric Propulsion Conference, Colorado Springs, Colo., 11-13 May 1987; sponsored by AIAA, DGLR and JSASS (NASA-TM-89860; E-3527; NAS 1.15:89860; AIAA-87-0994) Avail: NTIS HC A03/MF A01 CSCL 09C

Resistojets are operational on many geosynchronous communication satellites which all use dc power buses. Multipropellant resistojets were selected for the Initial Operating Capability (IOC) Space Station which will supply 208 V, 20 kHz power. This paper discusses resistojet heater temperature controllers and passive power regulation methods for ac power systems. A simple passive power regulation method suitable for use with regulated sinusoidal or square wave power was designed and tested using the Space Station multipropellant resistojet. The breadboard delivered 20 kHz power to the resistojet heater. Cold start surge current limiting, a power efficiency of 95 percent, and power regulation of better than 2 percent were demonstrated with a two component, 500 W breadboard power controller having a mass of 0.6 kg.

N87-20577# Air Force Office of Scientific Research, Bolling AFB, Washington, D.C. Aerospace Sciences.

# AIR FORCE BASIC RESEARCH IN DYNAMICS AND CONTROL OF LARGE SPACE STRUCTURES

ANTHONY K. AMOS In Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 1: Welcome, Invited Papers, Shipboard Shock, Blast and Ground Shock, Shock Testing and Analysis p 39-58 Aug. 1986

Avail: NTIS HC A13/MF A01

The Air Force Basic Research in dynamics and control of large space structures addresses several of the many scientific and technological issues relating to the development and operation of very large and sophisticated high performance systems in the

relatively unfamiliar space environment. The design challenge has motivated most of the ongoing research to date. It is perceived that these have evolved modeling concepts, computational algorithms, and performance/stability criteria capable of supporting the design process. However, analytical and experimental methods and the experience data base needed to support the validation of designs prior to commitment to launch are still sparse or nonexistent. The program is therefore in the process of shifting emphasis from the synthesis to the simulation objectives of the technologies. It is entended to embark on the development of modeling and computational capabilities needed to perform high fidelity simulation of orbital dynamics including operational maneuvers and developmental functions of deployment and assembly.

National Aeronautics and Space Administration. N87-20665\*# Marshall Space Flight Center, Huntsville, Ala. UPPER AND MIDDLE ATMOSPHERIC DENSITY MODELING REQUIREMENTS FOR SPACECRAFT DESIGN AND **OPERATIONS** 

M. H. DAVIS, ed. (Universities Space Research Association, Boulder, Colo.), R. E. SMITH, ed., and D. L. JOHNSON, ed. Feb. 1987 290 p Workshop held in Huntsville, Ala., 19-21 1985 (Contract NAS8-36400)

(NASA-CP-2460; M-548; NAS 1.55:2460) Avail: NTIS HC A13/MF A01 CSCL 04A

Presented and discussed are concerns with applications of neutral atmospheric density models to space vehicle engineering design and operational problems. The area of concern which the atmospheric model developers and the model users considered, involved middle atmosphere (50 to 90 km altitude) and thermospheric (above 90 km) models and their engineering application. Engineering emphasis involved areas such as orbital decay and lifetime prediction along with attitude and control studies for different types of space and reentry vehicles.

National Aeronautics and Space Administration. N87-20668\*# Marshall Space Flight Center, Huntsville, Ala.

SPACE STATION MOMENTUM MANAGEMENT

V. BUCKALEW and MIRIAM HOPKINS In its Upper and Middle Atmospheric Density Modeling Requirements for Spacecraft Design and Operations p 41-57 Feb. 1987

Avail: NTIS HC A13/MF A01 CSCL 22B Gravity gradient stabilization is planned for the space station.

Torques arise from air-drag since the center of pressure is not the same as the center of mass of the satellite. The magnitude of these torques varies depending upon the orientation of the solar panels. Adjustments are made through the use of CMG's (Control Moment Gyros). In time, if the CMG's saturate, torque must be bled off using thrusters; however, that is undesirable because it expends propellant and contaminates the local environment. The task of the engineer is to design the CMG's to handle the aerodynamic torques and design the configuration of the spacecraft to prevent, if possible, CMG saturation. For this application the long-term atmospheric density trends are of less importance than the rate of change of density within an orbit. In principle, CMG's could be designed for the worst case of maximum solar activity, but the penalty for overdesign is excess mass and cost. In summary, present models are inadequate for this application with the greatest need being a reliable prediction of maximum rates-of-change of density within an orbit.

National Aeronautics and Space Administration. N87-20669\*# Lyndon B. Johnson Space Center, Houston, Tex.

SPACE STATION CONTROL MOMENT GYRO CONTROL ALDO BORDANO In NASA. Marshall Space Flight Center Upper

and Middle Atmospheric Density Modeling Requirements for Spacecraft Design and Operations p 59-71 Feb. 1987 Avail: NTIS HC A13/MF A01 CSCL 22B

The potential large center-of-pressure to center-of-gravity offset of the space station makes the short term, within an orbit, variations in density of primary importance. The large range of uncertainty in the prediction of solar activity will penalize the design, Author developments, and operation of the space station.

N87-21335 California Univ., Berkeley. DYNAMICS OF FLEXIBLE STRUCTURES PERFORMING LARGE OVERALL MOTIONS: A GEOMETRICALLY-NONLINEAR APPROACH Ph.D. Thesis LOC QUOC VU 1986 231 p

Avail: Univ. Microfilms Order No. DA8624976

The modeling of flexible structures subjected to large overall motions is discussed. Applications span diverse disciplines: from robotics and machine design to aircraft and spacecraft dynamics. Traditional approaches to this class of problems are based on the assumption of small deformations, thus relying crucially on the use of a floating reference frame. The resulting set of equations of motion is nonlinear and highly coupled in the inertia terms. By contrast, an alternative approach is proposed in which fully nonlinear structural theories, which are properly invariant with respect to superposed rigid body motions, are employed. Owing to this property, the dynamics of motion can be referred directly to the inertial frame, leading to a drastic simplification of the inertia operator (with a structure identical to that found in rigid body mechanics). Even though the methodology applies to a general class of structural elements, only a one-dimensional type (flexible rod) is considered. The dynamics of Earth-orbiting flexible satellites are completely described by the same system of equations of motion as for the fully nonlinear rod model. Applications of the proposed methodology to the dynamics of flexible multibody systems (rigid bodies with flexible appendages, all flexible chain systems, flexible closed-loop chains) are also considered.

Dissert, Abstr.

N87-21989 Ohio State Univ., Columbus. VARIABLE STRUCTURE CONTROL SYSTEM MANEUVERING OF SPACECRAFT Ph.D. Thesis

OSAMA ABDERRHMAN MOSTAFA 1986 152 p Avail: Univ. Microfilms Order No. DA8625264

Variable structure control systems (VSCS) are a class of nonlinear systems which change the structure of the controls when a set of prescribed hypersurfaces are reached in the phase space. The theory represents a real-time implementable approach to control in contrast to algorithmic approaches, and therefore eliminates the computational burden. This dissertation applies the VSCS theory to maneuvering of a rigid spacecraft with four momentum exchange wheels and maneuvering of a flexible spacecraft. General nonlinear equations of motion are presented for the three-axes maneuver of the rigid spacecraft and for a single axis maneuver of the flexible spacecraft. Three methods are presented for designing variable structure control logics. The theory is demonstrated for set point regulation, tracking, disturbance accommodation, spin-up and robust maneuvers of specific spacecraft configurations. A practical problem in the implementation of VSCS theory is the possibility of chatter about hypersurfaces known as sliding regimes. Three methods of chatter alleviation are introduced. Specifically, the methods are: a boundary layer approach, asymptotic reaching of sliding regimes, and digital input Dissert. Abstr. prefiltering.

National Aeronautics and Space Administration. N87-21993\*# Marshall Space Flight Center, Huntsville, Ala.

EQUATIONS OF MOTION OF A SPACE STATION WITH EMPHASIS ON THE EFFECTS OF THE GRAVITY GRADIENT L. P. TUELL Mar. 1987 127 p

(NASA-TM-86588; NAS 1.15:86588) Avail: NTIS HC A07/MF A01 CSCL 22B

The derivation of the equations of motion is based upon the principle of virtual work. As developed, these equations apply only to a space vehicle whose physical model consists of a rigid central carrier supporting several flexible appendages (not interconnected), smaller rigid bodies, and point masses. Clearly evident in the equations is the respect paid to the influence of the Earth's gravity field, considerably more than has been the custom in simulating vehicle motion. The effect of unpredictable crew motion is

N87-21994\*# Astro Aerospace Corp., Carpinteria, Calif. STRUCTURAL CONCEPTS FOR LARGE SOLAR **CONCENTRATORS Final Report** 

JOHN M. HEDGEPETH and RICHARD K. MILLER Washington NASA 1987 66 p

(Contract NAS1-17536)

(NASA-CR-4075; NAS 1.26:4075) Avail: NTIS HC A04/MF A01

The Sunflower large solar concentrator, developed in the early 1970's, is a salient example of a high-efficiency concentrator. The newly emphasized needs for solar dynamic power on the Space Station and for large, lightweight thermal sources are outlined. Existing concepts for high efficiency reflector surfaces are examined with attention to accuracy needs for concentration rates of 1000 to 3000. Concepts using stiff reflector panels are deemed most likely to exhibit the long-term consistent accuracy necessary for low-orbit operation, particularly for the higher concentration ratios. Quantitative results are shown of the effects of surface errors for various concentration and focal-length diameter ratios. Cost effectiveness is discussed. Principal sources of high cost include the need for various dished panels for paraboloidal reflectors and the expense of ground testing and adjustment. A new configuration is presented addressing both problems, i.e., a deployable Pactruss backup structure with identical panels installed on the structure after deployment in space. Analytical results show that with reasonable pointing errors, this new concept is capable of concentration ratios greater than 2000.

#### N87-22060 California Univ., Los Angeles. INTEGRATED CONTROL/STRUCTURE DESIGN AND **ROBUSTNESS Ph.D. Thesis**

ARMEN ADAMIAN 1986 198 p

Avail: Univ. Microfilms Order No. DA8702603

When a flexible structure is to be controlled actively, optimum performance is obtained by integrated, or simultaneous, design of the structure and the controller, as opposed to the common practice of designing the structure independently of control considerations and then designing a controller for a fixed structure. The primary design objective from the structural point of view usually is to minimize weight, while the control design objectives depend on the application. An important requirement for a practical control system is robustness with respect to uncertain plant parameters. Robust compensator design for fixed structures, and simultaneous control/structure design where the overall design objective combines the weight of the structure and the robustness of the closed-loop control system are discussed. For numerical optimization, robustness is represented by the sensitivity of the closed-loop eigenvalues with respect to uncertain parameters. An example illustrates the closed-loop control system with robust compensator, and two examples illustrate the optimal designs of a flexible structure along with robust compensators. Different finite element models are compared to determine models most efficient for compensator design. Dissert. Abstr.

National Aeronautics and Space Administration. N87-22702\*# Marshall Space Flight Center, Huntsville, Ala.

#### STRUCTURAL DYNAMICS AND CONTROL INTERACTION OF **FLEXIBLE STRUCTURES**

ROBERT S. RYAN, ed. and HAROLD N. SCOFIELD, ed. Apr. 680 p Workshop held in Huntsville, ALa., 22-24 Apr. 1986

(NASA-CP-2467-PT-1; M-554-PT-1; NAS 1.55:2467-PT-1) Avail: NTIS HC A99/MF E03 CSCL 22B

A workshop on structural dynamics and control interaction of flexible structures was held to promote technical exchange between the structural dynamics and control disciplines, foster joint technology, and provide a forum for discussing and focusing critical issues in the separate and combined areas. Issues and areas of emphasis were identified in structure-control interaction for the next generation of flexible systems.

N87-22706\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

MICROPROCESSOR CONTROLLED PROOF-MASS ACTUATOR GARNETT C. HORNER In NASA, Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 101-118 Apr. 1987

Avail: NTIS HC A99/MF E03 CSCL 14B

The objective of the microprocessor controlled proof-mass actuator is to develop the capability to mount a small programmable device on laboratory models. This capability will allow research in the active control of flexible structures. The approach in developing the actuator will be to mount all components as a single unit. All sensors, electronic and control devices will be mounted with the actuator. The goal for the force output capability of the actuator will be one pound force. The programmable force actuator developed has approximately a one pound force capability over the usable frequency range, which is above 2 Hz.

#### N87-22708\*# Auburn Univ., Ala. SPACE STATION/SHUTTLE ORBITER DYNAMICS DURING

N. G. FITZ-COY and J. E. COCHRAN, JR. In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 133-174 Apr. 1987 Avail: NTIS HC A99/MF E03 CSCL 22B

Mathematical models of a reference space station configuration (Power Tower) and a Space Shuttle Orbiter are developed and used to study the dynamic behavior of the Space Station/Orbiter system just prior to and subsequent to an impulsive docking of the two spacecraft. The physical model of the space station is a collection of rigid and flexible bodies. The orbiter is modeled as a rigid body. An algorithm developed for use in digitally simulating the dynamics of the system is described and results of its application are presented.

N87-22714\*# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.

#### OPTIMUM MIX OF PASSIVE AND ACTIVE CONTROL OF **SPACE STRUCTURES**

LYNN ROGERS and KEN RICHARDS (Martin Marietta Aerospace, Denver, Colo.) In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 275-292 Apr. 1987

Avail: NTIS HC A99/MF E03 CSCL 22B

The objective of this research was to test vibration suppression (settling time and jitter) of a large space structure (LSS) characterized by low frequency high global vibration modes. Five percent passive damping in a large truss was analyzed, tested and correlated. A representative system article re-target analysis shows that modest levels of passive damping dramatically reduce the control energy required. LSS must incorporate passive damping from the outset. The LSS system performance will not be met by either active or passive damping alone.

#### N87-22715\*# Control Dynamics Co., Huntsville, Ala. ONE CONTROLLER AT A TIME (1-CAT): A MIMO DESIGN **METHODOLOGY**

J. R. MITCHELL and J. C. LUCAS In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 293-334 Apr. 1987

Avail: NTIS HC A99/MF E03 CSCL 22B

The One Controller at a Time (1-CAT) methodology for designing digital controllers for Large Space Structures (LSS's) is introduced and illustrated. The flexible mode problem is first discussed. Next, desirable features of a LSS control system design methodology are delineated. The 1-CAT approach is presented, along with an analytical technique for carrying out the 1-CAT process. Next, 1-CAT is used to design digital controllers for the proposed Space Based Laser (SBL). Finally, the SBL design is evaluated for dynamical performance, noise rejection, and robustness.

National Aeronautics and Space Administration. N87-22717\*# Langley Research Center, Hampton, Va.

STATUS REPORT AND PRELIMINARY RESULTS OF THE SPACECRAFT CONTROL LABORATORY EXPERIMENT

JEFFREY P. WILLIAMS In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures Apr. 1987

Avail: NTIS HC A99/MF E03 CSCL 22B

The Spacecraft Control Laboratory Experiment (SCOLE) was conceived to provide a physical test bed for investigation of control techniques for large flexible spacecraft. The SCOLE problem is defined as two design challenges. The first challenge is to design control laws for a mathematical model of a large antenna attached to the space shuttle by a long flexible mast. The second challenge is to design and implement a control scheme on a laboratory representation of the structure modelled in the first part. Control sensors and actuators are typical of those which the control designer would have to deal with on an actual spacecraft. The primary control processing computer is representative of the capacity and speed which may be expected in actual flight computers. A brief description is given of the laboratory apparatus along with some preliminary results of structural dynamics tests and actuator effectiveness tests.

N87-22720\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

#### AN OVERVIEW OF CONTROLS RESEARCH ON THE NASA LANGLEY RESEARCH CENTER GRID

RAYMOND C. MONTGOMERY In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 435-456 Apr. 1987 Avail: NTIS HC A99/MF E03 CSCL 20K

The NASA Langley Research Center has assembled a flexible grid on which control systems research can be accomplished on a two-dimensional structure that has many physically distributed sensors and actuators. The grid is a rectangular planar structure that is suspended by two cables attached to one edge so that out of plane vibrations are normal to gravity. There are six torque wheel actuators mounted to it so that torque is produced in the grid plane. Also, there are six rate gyros mounted to sense angular motion in the grid plane and eight accelerometers that measure linear acceleration normal to the grid plane. All components can be relocated to meet specific control system test requirements. Digital, analog, and hybrid control systems capability is provided in the apparatus. To date, research on this grid has been conducted in the areas of system and parameter identification, model estimation, distributed modal control, hierarchical adaptive control, and advanced redundancy management algorithms. presentation overviews each technique and presents the most Author significant results generated for each area.

#### N87-22723\*# Boeing Aerospace Co., Seattle, Wash. PRECISION POINTING AND CONTROL OF FLEXIBLE

M. H. BANTELL, JR. In NASA, Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 505-538 Apr. 1987

Avail: NTIS HC A99/MF E03 CSCL 22B

The problem and long term objectives for the precision pointing and control of flexible spacecraft are given. The four basic objectives are stated in terms of two principle tasks. Under Task 1, robust low order controllers, improved structural modeling methods for control applications and identification methods for structural dynamics are being developed. Under Task 2, a lab test experiment for verification of control laws and system identification algorithms is being developed. For Task 1, work has focused on robust low order controller design and some initial considerations for structural modeling in control applications. For Task 2, work has focused on experiment design and fabrication, with sensor selection and initial digital controller implementation. Conclusions are given. Author

National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

#### STRUCTURAL DYNAMICS AND CONTROL INTERACTION OF FLEXIBLE STRUCTURES

ROBERT S. RYAN, ed. and HAROLD N. SCOFIELD, ed. Workshop held in Huntsville, Ala., 22-24 Apr. 729 p 1986

(NASA-CP-2467-PT-2; M-554-PT-2; NAS 1.55:2467-PT-2) Avail: NTIS HC A99/MF E03 CSCL 22B

A Workshop was held to promote technical exchange between the structural dynamic and control disciplines, foster joint technology, and provide a forum for discussing and focusing critical issues in the separate and combined areas. The workshop was closed by a panel meeting. Panel members' viewpoints and their responses to questions are included.

#### N87-22730\*# California Inst. of Tech., Pasadena. **VIBRATION SUPPRESSION BY STIFFNESS CONTROL**

JAMES FANSON, THOMAS CAUGHEY, and JAY CHEN In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 693-758 Apr. 1987 Avail: NTIS HC A99/MF E03 CSCL 20K

The feasibility of using piezoelectric ceramics as both sensors and actuators for vibration suppression in a lightweight, flimsy structure was demonstrated. Multimode control was achieved using one sensor and actuator pair. The Positive Position Feedback control strategy requires only knowledge of the natural frequencies of the structure. Implementation of the Positive Position Feedback used only strain measurements to achieve damping, no velocities, or acceleration are needed. All spillover is stabilizing for sufficient small gains.

#### N87-22731\*# Texas A&M Univ., College Station. A QUASI-ANALYTICAL METHOD FOR NON-ITERATIVE COMPUTATION OF NONLINEAR CONTROLS

J. L. JUNKINS, R. C. THOMPSON, and J. D. TURNER (Cambridge Research Associates, Mass.) In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 759-774 Apr. 1987 Avail: NTIS HC A99/MF E03 CSCL 22B

An optimal control solution process was developed for a general class of nonlinear dynamical systems. The method combines control theory, perturbation methods, and Van Loan's recent matrix exponential results. A variety of applications support the practical utility of this method. Nonlinear rigid body optimal maneuvers are routinely solved. Flexible body dynamical systems of an order greater than 40 were solved. The method fails occasionally due to poor convergence of the perturbation expansion or numerical difficulties associated with computing the matrix exponential. The method is attractive because it appears to be a good candidate for semi-automation; no initial guess is required, and it usually converges at 2nd or 3rd order in minutes of machine time.

National Aeronautics and Space Administration. N87-22732\*# Langley Research Center, Hampton, Va.

## CONTROL OF FLEXIBLE STRUCTURES AND THE RESEARCH

CLAUDE R. KECKLER and JON S. PYLE In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 789-840 Apr. 1987

Avail: NTIS HC A99/MF E03 CSCL 22B

The Control of Flexible Structures II (CPFS) program is a complex and ambitious undertaking which addresses several critical technology areas. Among them are modeling, structural dynamics, control, and ground testing issues, which are also applicable to other large space structure programs being contemplated. This effort requires early integration of controls and structural dynamic considerations. Several technological advances must be achieved in the areas of system modeling, control synthesis and methodology, sensor/actuator development, and ground testing techniques for system evaluation and on-orbit performance prediction and verification. This program offers an opportunity for the integration of several disciplines to produce technology advances which will benefit many future programs.

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics. MANEUVERING AND VIBRATION CONTROL OF FLEXIBLE

L. MEIROVITCH and R. D. QUINN In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 867-880 Apr. 1987 (Contract NAG1-225)

Avail: NTIS HC A99/MF E03 CSCL 22B

Equations of motion, control strategy, perturbation, rigid-body maneuvers, quasi-modal equations, and vibration control are discussed for flexible spacecraft.

N87-22736\*# Rockwell International Corp., Downey, Calif. Space Station Systems Div.

#### PRELIMINARY EVALUATION OF A REACTION CONTROL SYSTEM FOR THE SPACE STATION

H. H. WOO and J. A. FINLEY In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 930-942 Apr. 1987 Avail: NTIS HC A99/MF E03 CSCL 22B

The challenge, ground rules and criteria, some of the Reaction Control System (RCS) concepts, classical and modern design analysis, and simulation results which are applicable to the space station are presented.

N87-22737\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

#### **DUAL KEEL SPACE STATION CONTROL/STRUCTURES** INTERACTION STUDY

JOHN W. YOUNG, FREDERICK J. LALLMAN, and PAUL A. COOPER In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 945-978 Apr. 1987

Avail: NTIS HC A99/MF E03 CSCL 22B

A study was made to determine the influence of truss bay size on the performance of the space station control system. The objective was to determine if any control problems existed during reboost and to assess the level of potential control/structures interaction during operation of the control moment gyros used for vertical stabilization. The models analyzed were detailed finite-element representations of the 5 meter and 9 foot growth versions of the 300 kW dual keel station. Results are presented comparing the performance of the reboost control system for both versions of the space station. Standards for comparison include flexible effects at the attitude control sensor locations and flexible contributions to pointing error at the solar collectors. Bode analysis results are presented for the attitude control system and control, structural, and damping sensitivities are examined.

N87-22742\*# Lockheed Missiles and Space Co., Sunnyvale, Calif. Space Systems Div.

#### VIBRATION ISOLATION FOR LINE OF SIGHT PERFORMANCE **IMPROVEMENT**

J. J. RODDEN, H. J. DOUGHERTY, and W. B. HAILE In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 1071-1078 Apr. 1987 Avail: NTIS HC A99/MF E03 CSCL 20K

Diagrams of the Reaction Wheel Assembly (RWA) are presented along with charts and graphs illustrating jitter error model, induced vibration tests, radial displacement transfer function, and axial displacement power spectra density. The RWA isolator specification requirements are listed.

#### N87-22746\*# DYNACS Engineering Co., Inc., Clearwater, Fla. NOTES ON IMPLEMENTATION OF COULOMB FRICTION IN COUPLED DYNAMICAL SIMULATIONS

R. J. VANDERVOORT and R. P. SINGH In NASA, Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 1197-1213 Apr. 1987 Avail: NTIS HC A99/MF E03 CSCL 20K

A coupled dynamical system is defined as an assembly of rigid/flexible bodies that may be coupled by kinematic connections. The interfaces between bodies are modeled using hinges having 0 to 6 degrees of freedom. The equations of motion are presented for a mechanical system of n flexible bodies in a topological tree configuration. The Lagrange form of the D'Alembert principle was employed to derive the equations. The equations of motion are augmented by the kinematic constraint equations. augmentation is accomplished via the method of singular value decomposition.

N87-22752\*# Alabama Univ., Huntsville. Dept. of Mechanical Engineering.

#### ANALYTICAL DETERMINATION OF SPACE STATION RESPONSE TO CREW MOTION AND DESIGN OF SUSPENSION SYSTEM FOR MICROGRAVITY EXPERIMENTS

FRANK C. LIU In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p Apr. 1987 Previously announced as N86-24535 1333-1366 (Contract NGT-01-008-021)

Avail: NTIS HC A99/MF E03 CSCL 22B

The objective of this investigation is to make analytical determination of the acceleration produced by crew motion in an orbiting space station and define design parameters for the suspension system of microgravity experiments. A simple structural model for simulation of the IOC space station is proposed. Mathematical formulation of this model provides the engineers a simple and direct tool for designing an effective suspension system.

N87-22753\*# Martin Marietta Aerospace, Denver, Colo. Analytical Mechanics.

#### SPACE STATION STRUCTURAL DYNAMICS/REACTION CONTROL SYSTEM INTERACTION STUDY

M. PINNAMANENI and J. MURRAY In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 1367-1394 Apr. 1987 Avail: NTIS HC A99/MF E03 CSCL 22B

The performance of the Reaction Control System is impacted

by the extreme flexibility of the space station structure. The method used to analyze the periodic thrust profile of a simple form of phase plane logic is presented. The results illustrate the effect on flexible body response of the type of phase plane logic utilized and the choice of control parameters: cycle period and attitude deadband.

N87-22758\*# Allied Bendix Aerospace, Teterboro, N.J. Guidance Systems Div.

#### ADAPTIVE MOMENTUM MANAGEMENT FOR LARGE SPACE STRUCTURES Final Report, 1 May 1986 - 31 Jan. 1987

E. HAHN 10 Feb. 1987 43 p (Contract NAS8-36488)

(NASA-CR-179085; NAS 1.26:179085) Avail: NTIS HC A03/MF A01 CSCL 22B

Momentum management is discussed for a Large Space Structure (LSS) with the structure selected configuration being the Initial Orbital Configuration (IOC) of the dual keel space station. The external forces considered were gravity gradient and aerodynamic torques. The goal of the momentum management scheme developed is to remove the bias components of the external torques and center the cyclic components of the stored angular momentum. The scheme investigated is adaptive to uncertainties of the inertia tensor and requires only approximate knowledge of principle moments of inertia. Computational requirements are minimal and should present no implementation problem in a flight type computer and the method proposed is shown to be effective in the presence of attitude control bandwidths as low as .01 radian/sec.

N87-22761# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

MOVING-BANK MULTIPLE MODEL ADAPTIVE ESTIMATION APPLIED TO FLEXIBLE SPACESTRUCTURE CONTROL M.S.

DREW A. KARNICK Dec. 1986 213 p (AD-A178870; AFIT/GE/ENG/86D-41) Avail: NTIS HC A10/MF A01 CSCL 22B

A significant problem in estimation and control is the uncertainty of parameters in the mathematical model used in the design of controllers and/or estimators. These parameters may be unknown, varying slowly, or changing abruptly due to a failure in the physical system. These changes in parameters often necessitate the identification of parameters within the mathematical model and changing the mathematical model during a real-time control problem. This is often referred to as adaptive control and/or estimation. This thesis investigates methods of adaptive control implementing a moving-bank multiple model adaptive estimator.

**GRA** 

N87-23681# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

AN ANALYSIS OF SPACE STATION MOTION SUBJECT TO THE PARAMETRIC EXCITATION OF PERIODIC ELEVATOR MOTION M.S. Thesis

JOHN D. CHAN Dec. 1986 83 p (AD-A179235; AFIT/GA/AA/86D-2) Avail: NTIS HC A05/MF A01 CSCL 06S

This study will derive the equations of attitude motion for a gravity gradient stabilized space station whose moments of inertia are varying with time. The equations are then linearized, after which an analytical solution of the pitch equation is developed. An examination of the stability of motion for the resulting Hill equation is presented and then compared to the solution obtained from numerical integration of the nonlinear equations. The results show that for elevator frequencies on the order of the orbit rate, motion can grow unboundedly with time. Consequently, the shape of the classical Lagrange stability region is altered.

N87-23687\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

OPTIMIZATION OF PAYLOAD MASS PLACEMENT IN A DUAL KEEL SPACE STATION

MELVIN J. FEREBEE, JR. and ROBERT B. POWERS Mar. 1987 23 p

(NASA-TM-89051; NAS 1.15:89051) Avail: NTIS HC A02/MF

In order to keep a Space Station in a stable low-Earth orbit, angular momentum storage and translational attitude control systems will have to be used. In order to minimize the size of these attitude control systems, the induced gravity gradient torque effects will have to be minimized. This can be done by minimizing the cross-products of inertia of the Station through the management of payload placement with the Station geometry. A derived and automated methodology is presented which utilizes mathematical nonlinear programming techniques. An optimal arrangement of a set of five payloads on a Dual Keel Space Station was found that minimized the cross products of inertia and thus the required controllability resources.

N87-23690\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

CONTROL CONSIDERATIONS FOR HIGH FREQUENCY, RESONANT, POWER PROCESSING EQUIPMENT USED IN LARGE SYSTEMS

J. W. MILDICE, K. E. SCHREINER, and F. WOLFF 1987 8 p Prepared for presentation at the 22nd Intersociety Energy Conversion Engineering Conference, Philadelphia, Pa., 10-14 Aug. 1987; cosponsored by AIAA, ANS, ASME, SAE, IEEE, ACS, and AIChE

Addressed is a class of resonant power processing equipment

designed to be used in an integrated high frequency (20 KHz domain), utility power system for large, multi-user spacecraft and other aerospace vehicles. It describes a hardware approach, which has been the basis for parametric and physical data used to justify the selection of high frequency ac as the PMAD baseline for the space station. This paper is part of a larger effort undertaken by NASA and General Dynamics to be sure that all potential space station contractors and other aerospace power system designers understand and can comfortably use this technology, which is now widely used in the commercial sector. In this paper, we will examine control requirements, stability, and operational modes; and their hardware impacts from an integrated system point of view. The current space station PMAD system will provide the overall requirements model to develop an understanding of the performance of this type of system with regard to: (1) regulation; (2) power bus stability and voltage control; (3) source impedance; (4) transient response; (5) power factor effects, and (6) limits and overloads.

## N87-24028# Oak Ridge National Lab., Tenn. APPLICATION OF ADVANCED FLYWHEEL TECHNOLOGY FOR ENERGY STORAGE ON SPACE STATION

M. OLSZEWSKI Apr. 1987 11 p Presented at the Space Electrochemical Research and Technology Conference, Cleveland, Ohio, 14 Apr. 1987

(Contract DE-AC05-84OR-21400)

(DE87-007657; CONF-8704101-1) Avail: NTIS HC A02/MF A01

In space power applications where solar inputs are the primary thermal source, energy storage is necessary to provide a continuous power supply during the eclipse portion of the orbit. Because of their potentially high storage density, flywheels are being considered for use as the storage system on the proposed orbiting space station. During the past several years graphite fiber technology has advanced, leading to significant gains in flywheel storage density. Use of these improved fibers in experimental flywheel rims has resulted in ultimate storage densities of 878 kJ/kg. With these high-strength graphite fibers, operational storage densities for flywheel storage modules applicable to the space station power storage could reach 200 kJ/kg. This module would also be volumetrically efficient occupying only about 1 cu m. Because the size and mass of the flywheel storage module are controlled by the storage density, improvements in fiber strength can have a significant impact on these values. With the improvements anticipated within the next five years, operational storage density on the order of 325 kJ/kg may be possible for the flywheel module.

N87-24490# Aeritalia S.p.A., Naples (Italy). Space Systems

ATTITUDE AND ORIENTATION SYSTEM (AOCS) TASKS ON RENDEZVOUS AND DOCKING (RVD) (DOCKING-UNDOCKING PHASES). ARCHITECTURE OF THE WHOLE SIMULATOR, VOLUME 2 Final Report

Paris, France ESA Feb. 1986 270 p (Contract ESA-4750/81-NL-AK(SC))

(LP-RP-AI-204-VOL-2; ESA-CR(P)-2313-VOL-2; ETN-87-99869)

Avail: NTIS HC A12/MF A01

The architecture of a spacecraft docking simulator is described. The main functions are: geometrical definition of the spacecraft shape and of the interfacing docking mechanism; dynamic definition of the spacecraft in terms of mass, inertia, stiffness, damping, flexible eigenvectors, and eigenvalues; geometrical interference analysis, localization of the impact point, force or impulse exchanged, integration step control (PREP); preparation and manipulation of the input-output information flow between PREP and DCAP-1; motion simulation (DCAP-1); postelaboration of the output of DCAP-1, reconstruction of the whole geometry; and its visualization.

N87-24491# Aeritalia S.p.A., Naples (Italy). Space Systems Group.

ATTITUDE AND ORIENTATION CONTROL SYSTEM (AOCS) TASKS ON RENDEZVOUS AND DOCKING (RVD) (DOCKING-UNDOCKING PHASES). SIMULATION SET-UP AND **RESULTS, VOLUME 3 Final Report** 

Paris, France ESA Feb. 1986 151 p (Contract ESA-4750/81-NL-AK(SC))

(LP-RP-Al-204-VOL-3; ESA-CR(P)-2313-VOL-3; ETN-87-99870)

Avail: NTIS HC A08/MF A01

Simulations of cone-cone docking between two rigid bodies; cone-cone docking with a flexible target; and probe-cone docking with rigid target and chaser were performed. Results show that a general purpose DCAP-1 integrated software dedicated to docking is unfeasible. The DCAP code has problems in handling system nontopology due to the way it considers hinges. Ways to overcome these problems are suggested.

N87-24498\*# General Dynamics Corp., Fort Worth, Tex. LARGE SPACECRAFT POINTING AND SHAPE CONTROL ARTHUR L. HALE In NASA-Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 p 603-635 1987

Avail: NTIS HC A14/MF A01 CSCL 22B

The overall objective of this program was the development of control algorithms that allow the concurrent operation of slewing, pointing, vibration, and shape control subsystems. This objective is important for near-term space surveillance missions that require the rapid retargeting and precise pointing of large flexible satellites. The success of these missions requires the design and concurrent operation of the various interacting control subsystems. There were two phases conducted: phase 1 was mathematical model development, and phase 2 was control development. The program is detailed and major conclusions given.

N87-24502\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

CONTROLS-STRUCTURES-ELECTROMAGNETICS INTERACTION PROGRAM

WILLIAM L. GRANTHAM, MARION C. BAILEY, WENDELL K. BELVIN, and JEFFREY P. WILLIAMS In its NASA/DOD Control/Structures Interaction Technology, 1986 p 701-715 Jun. 1987

Avail: NTIS HC A14/MF A01 CSCL 22B

A technology development program is described involving Controls Structures Electromagnetics Interaction (CSEI) for large space structures. The CSEI program was developed as part of the continuing effort following the successful kinematic deployment and RF tests of the 15 meter Hoop/Column antenna. One lesson learned was the importance of making reflector surface adjustment after fabrication and deployment. Given are program objectives, ground based test configuration, Intelsat adaptive feed, reflector shape prediction model, control experiment concepts, master schedule, and Control Of Flexible Structures-II (COFS-II) baseline configuration. Author

N87-24506\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

COFS 3 MULTIBODY DYNAMICS AND CONTROL

**TECHNOLOGY** 

ROBERT LETCHWORTH, PAUL E. MCGOWAN, and MARC J. GRONET (Lockheed Missiles and Space Co., Sunnyvale, Calif.) In its NASA/DOD Control/Structures Interaction Technology, 1986 p 757-765 Jun. 1987

Avail: NTIS HC A14/MF A01 CSCL 22B

One of the results from the model definition study showed that the maximum scale factor for a replica model is .25. This is dictated by the fixed dimensions of the Large Spacecraft Lab. Replica scaling laws were applied to simplified theoretical models of joints and the joint/tube/joint system. The practical interpretation of the results for the specific Space Station configuration under study yielded a number of conclusions which are briefly discussed. Detailed suspension analyses were conducted to evaluate the

ability of the suspended scale model to emulate the dynamic behavior of the free-free Space Station. The results indicated only a slight preference for smaller scales. A candidate erectable Space Station ioint was fabricated at full scale, 1/4 scale and 1/3 scale in order to assess the comparability of the scaled joints to the full scale behavior. Another important question discussed is how well the inherent damping characteristics of the scaled joints compare to those of the full scale joint. The preliminary definition study yielded three separate scale factor recommendations for the scale model.

N87-24507\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

CONTROL TECHNOLOGY OVERVIEW IN CSI
J. B. DAHLGREN and A. F. TOLIVAR In NASA-Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 p 767-778 Jun. 1987 Avail: NTIS HC A14/MF A01

CSCL 22B

A brief control technology overview is given in Control Structures Interaction (CSI) by illustrating that many future NASA mission present significant challenges as represented by missions having a significantly increased number of important system states which may require control and by identifying key CSI technology needs. The JPL CSI related technology developments are discussed to illustrate that some of the identified control needs are being pursued. Since experimental confirmation of the assumptions inherent in the CSI technology is critically important to establishing its readiness for space program applications, the areas of ground and flight validation require high priority.

N87-24509\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

#### STRUCTURAL CONTROL BY THE USE OF PIEZOELECTRIC **ACTIVE MEMBERS**

J. L. FANSON and J.-C. CHEN In NASA-Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 p 809-829 Jun. 1987

Avail: NTIS HC A14/MF A01 CSCL 22B

Large Space Structures (LSS) exhibit characteristics which make the LSS control problem different form other control problems. LSS will most likely exhibit low frequency, densely spaced and lightly damped modes. In theory, the number of these modes is infinite. Because these structures are flexible, Vibration Suppression (VS) is an important aspect of LSS operation. In terms of VS, the control actuators should be as low mass as possible, have infinite bandwidth, and be electrically powered. It is proposed that actuators be built into the structure as dual purpose structural elements. A piezoelectric active member is proposed for the control of LSS. Such a device would consist of a piezoelectric actuator and sensor for measuring strain, and screwjack actuator in series for use in quasi-static shape control. An experiment simulates an active member using piezoelectric ceramic thin sheet material on a thin, uniform cantilever beam. The feasibility of using the piezoelectric materials for VS on LSS was demonstrated. Positive positive feedback as a VS control strategy was implemented. Multi-mode VS was achieved with dramatic reduction in dynamic response. E.R.

N87-24511\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SLEW MANEUVERS ON THE SCOLE LABORATORY FACILITY JEFFREY P. WILLIAMS In its NASA/DOD Control/Structures Interaction Technology, 1986 p 851-867 Jun. 1987

Avail: NTIS HC A14/MF A01 CSCL 22B

The Spacecraft Control Laboratory Experiment (SCOLE) was conceived to provide a physical test bed for the investigation of control techniques for large flexible spacecraft. The control problems studied are slewing maneuvers and pointing operations. The slew is defined as a minimum time maneuver to bring the antenna line-of-sight (LOS) pointing to within an error limit of the pointing target. The second objective is to rotate about the LOS within the 0.02 degree error limit. The SCOLE problem is defined as two design challenges: control laws for a mathematical model

of a large antenna attached to the Space Shuttle by a long flexible mast; and a control scheme on a laboratory representation of the structure modelled on the control laws. Control sensors and actuators are typical of those which the control designer would have to deal with on an actual spacecraft. Computational facilities consist of microcomputer based central processing units with appropriate analog interfaces for implementation of the primary control system, and the attitude estimation algorithm. Preliminary results of some slewing control experiments are given.

N87-24512\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

RESEARCH IN SLEWING AND TRACKING CONTROL

Technology areas are identified in which better analytical and/or experimental methods are needed to adequately and accurately control the dynamic responses of multibody space platforms such as the Space Station and the Radiometer Spacecraft. A generic space station model is used to experimentally evaluate current control technologies and a radiometer spacecraft model is used to numerically test a new theoretical development for nonlinear three-axis maneuvers. Active suppression of flexible body vibrations induced by large angle maneuvers is studied with multiple torque inputs and multiple measurement outputs. These active suppression tests identify the hardware requirements and adequacy of various controller designs.

N87-24513\*# University of Southern California, Los Angeles. Dept. of Civil Engineering.

EVALUATION OF ON-LINE PULSE CONTROL FOR VIBRATION SUPPRESSION IN FLEXIBLE SPACECRAFT Final Technical Report

SAMI F. MASRI 13 Jul. 1987 32 p (Contract NAG1-636)

(NASA-CR-180391; NAS 1.26:180391; USC-53-4507-0031)

Avail: NTIS HC A03/MF A01 CSCL 22B

A numerical simulation was performed, by means of a large-scale finite element code capable of handling large deformations and/or nonlinear behavior, to investigate the suitability of the nonlinear pulse-control algorithm to suppress the vibrations induced in the Spacecraft Control Laboratory Experiment (SCOLE) components under realistic maneuvers. Among the topics investigated were the effects of various control parameters on the efficiency and robustness of the vibration control algorithm. Advanced nonlinear control techniques were applied to an idealized model of some of the SCOLE components to develop an efficient algorithm to determine the optimal locations of point actuators, considering the hardware on the SCOLE project as distributed in nature. The control was obtained from a quadratic optimization criterion, given in terms of the state variables of the distributed system. An experimental investigation was performed on a model flexible structure resembling the essential features of the SCOLE components, and electrodynamic and electrohydraulic actuators were used to investigate the applicability of the control algorithm with such devices in addition to mass-ejection pulse generators B.G. using compressed air.

N87-24514# Aeritalia S.p.A., Naples (Italy). Space Systems Group.

ATTITUDE AND ORIENTATION CONTROL SYSTEM (AOCS) TASKS ON RENDEZVOUS AND DOCKING (RVD) (DOCKING-UNDOCKING PHASES). DOCKING-UNDOCKING PHASE ANALYSIS Final Report

Paris, France ESA Feb. 1986 138 p (Contract ESA-4750/81-NL-AK(SC))

(LP-RP-AI-204-VOL-1; ESA-CR(P)-2313-VOL-1; ETN-87-99868)

Avail: NTIS HC A07/MF A01

The docking and undocking phases that comprise all operations leading from the first physical contact to the integral configuration of assembled spacecraft, and operations necessary to separate

the two satellites in case of malfunctioning of one of them were analyzed. Mathematical models are obtained from this analysis in order to simulate these phases using the DCAP-1 program and to obtain preliminary design evaluations and requirements for the relevant docking subsystems. A probe-drogue type mechanism, including mechanical damping; and the docking between rigid interfaces are considered.

N87-24521\*# National Aeronautics and Space Administration.
Marshall Space Flight Center, Huntsville, Ala.

DISTRIBUTED CONTROL USING LINEAR MOMENTUM EXCHANGE DEVICES

J. P. SHARKEY, HENRY WAITES, and G. B. DOANE, III (Control Dynamics Co., Huntsville, Ala.) Jun. 1987 50 p (NASA-TM-100308; NAS 1.15:100308) Avail: NTIS HC A03/MF A01 CSCL 22B

MSFC has successfully employed the use of the Vibrational Control of Space Structures (VCOSS) Linear Momentum Exchange Devices (LMEDs), which was an outgrowth of the Air Force Wright Aeronautical Laboratory (AFWAL) program, in a distributed control experiment. The control experiment was conducted in MSFC's Ground Facility for Large Space Structures Control Verification (GF/LSSCV). The GF/LSSCV's test article was well suited for this experiment in that the LMED could be judiciously placed on the ASTROMAST. The LMED placements were such that vibrational mode information could be extracted from the accelerometers on the LMED. The LMED accelerometer information was processed by the control algorithms so that the LMED masses could be accelerated to produce forces which would dampen the vibrational modes of interest. Experimental results are presented showing the LMED's capabilities.

N87-24723\*# National Aeronautics and Space Administration.

Marshall Space Flight Center, Huntsville, Ala.

CHARACTERIZATION AND HARDWARE MODIFICATION OF LINEAR MOMENTUM EXCHANGE DEVICES

GEORGE D. EDGEMON, SALLY CURTIS (Control Dynamics Co., Huntsville, Ala.), and HENRY B. WAITES Mar. 1987 44 p (NASA-TM-86594; NAS 1.15:86594) Avail: NTIS HC A03/MF A01 CSCL 20K

A sequence of modifications were made on the TRW Linear Momentum Exchange Devices (LMEDs) which were supplied for a joint MSFC/Air Force Wright Aeronautical Laboratory (AFWAL) control venture called Vibrational Control of Space Structures (VCOSS)-II. The modifications were necessary to alleviate and assuage the LMED nonlinearities. Extensive discussion of the LMED modification are presented along with the test plan, test results and conclusions. In addition, a chronology of events, relative to the LMED changes, is given.

N87-25350# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.

SOME PROBLEMS IN THE CONTROL OF LARGE SPACE STRUCTURES Final Report, 1 Jan. - 30 Jun. 1986

LEONARD MEIROVITCH 16 Dec. 1986 58 p (Contract AF-AFOSR-0017-83)

(AD-A179989; AFOSR-87-0426TR) Avail: NTIS HC A04/MF A01 CSCL 22B

Work during this period has been concerned with control of traveling waves in structures and developments in the control of distributed structures. In modal control of traveling waves, the question can be raised whether actuator forces at points removed from a given disturbance can begin working before the arrival of the disturbance. This question is prompted by the fact that modal forces begin acting at t = O. However, the modal forces are not the actual forces, although the actual actuator forces are linear combinations of the modal forces. It is demonstrated that these combinations are such that the control forces tend to concentrate in the immediate vicinity of the disturbance and tend to vanish at points removed from the disturbance. One problem in the control of distributed structures is that control implementation must be carried out by discrete actuators. In using direct feedback, whereby the sensors and actuators are collocated and the actuator input

depends only on the sensor output at the same location, asymptotic stability can be virtually guaranteed. Problems arise when one desires to place the closed-loop poles. It appears that there is some incompatibility between direct feedback and pole placement. In particular, in placing the poles for a number of controlled modes, the possibility of destabilizing uncontrolled modes exists. GRA

# N87-25352# Army Military Personnel Center, Alexandria, Va. SUBOPTIMAL CONTROL OF LARGE FLEXIBLE SPACE STRUCTURES EXPERIENCING ROTATIONAL DYNAMICS NONLINEARITIES Final Report

GEORGE D. MITROKA 8 May 1987 102 p

(AD-A180606) Avail: NTIS HC A06/MF A01 CSCL 22B

Developed is a method to determine a suboptimal smooth trajectory for large flexible space structures during rotational slewing maneuvers. It consists of minimizing the quadratic integral of the corresponding second time derivative of the generalized coordinate subject to specified boundary conditions. A parametric study examined the consequences of varying the number of design parameters and the number of specified boundary conditions. Study results include: (1) Additional degrees of freedom reduce the curvature of the trajectory, reduce the peak maneuver angle rate and only slightly increase the peak rigid-body torques on the structure during slewing maneuvers; (2) Additional boundary conditions result in smoother transitions at the end points between targeting maneuvers and increase the peak maneuver angle rate and rigid-body torques by a larger percentage than do additional design parameters. Next, planar dynamics equations of motion for a uniform, inextensible, cantilevered beam capable of small transverse deformations and which retain the rotational (centrifugal) nonlinearities are derived via Newton's Laws, nondimensionalized and cast into a form suitable for numerical integration.

N87-25355\*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

## DYNAMICS DURING THRUST MANEUVERS OF FLEXIBLE SPINNING SATELLITES WITH AXIAL AND RADIAL BOOMS

R. W. LONGMAN (Columbia Univ., New York.) and J. V. FEDOR In ESA Proceedings of the Second International Symposium on Spacecraft Flight Dynamics p 13-18 Dec. 1986

Avail: NTIS HC A22/MF A01 CSCL 22B

The dynamic response to operational maneuvers of spinning symmetric spacecraft with radial and axial booms was analyzed as part of the prelaunch dynamic analysis of the ISEE-3 spacecraft placed in a halo orbit around an Earth-Sun libration point, and later renamed ICE when it was directed to fly-by comet Giacobini-Zinner. The results presented use simple spacecraft models, and frequently give predictions that are good and easily obtained when the results from using a general purpose multibody dynamics program were very time consuming to obtain. Deployment of radial booms, spin-up after partial deployment, stationkeeping, and trajectory changes are analyzed. The latter two can involve both axial thrusting and pulsed radial thrusting once per revolution.

## N87-25356# Indian Inst. of Science, Bangalore. DYNAMICS OF AN ACTIVELY CONTROLLED FLEXIBLE EARTH OBSERVATION SATELLITE

S. K. SHRIVASTAVA, P. S. GOEL (Indian Space Research Organization, Bangalore.), M. SEETHARAMABHAT, and A. G. SREENATHA In ESA Proceedings of the Second International Symposium on Spacecraft Flight Dynamics p 19-24 Dec. 1986 Sponsored by the Indian Space Research Organization Avail: NTIS HC A22/MF A01

Attitude and flexural dynamics of an Earth-oriented satellite with a rigid main body and two large rectangular flexible Sun-tracking solar panels are presented. It is controlled using three reaction wheels operating on PWPFM logic with a modified Schmitt trigger and attitude sensors. The governing equations being highly nonlinear and coupled, numerical solution is resorted to. The system parameters corresponding to those of the Indian Remote Sensing satellite are used for the simulation. After studying the system performance, a modified controller with a 12th order Kalman filter

and observer introduced to reduce the effects of the sensor noise and to improve the system characteristics is considered. The effects of sampling and quantization of the sensor output are also studied.

N87-25358# Rome Univ. (Italy). Dept. of Informatica e Sistemistica.

## SAMPLED NONLINEAR CONTROL FOR LARGE ANGLE MANEUVERS OF FLEXIBLE SPACECRAFT

S. MONACO, D. N. CYROT, and S. STORNELLI (Telespazio, S.p.A., Rome, Italy) *In* ESA Proceedings of the Second International Symposium on Spacecraft Flight Dynamics p 31-38 Dec. 1986 Sponsored by Telespazio S.P.A.

Avail: NTIS HC A22/MF A01

A method for the design of attitude control systems for flexible spacecraft is presented. The design procedure employs input-output linearization and stabilization techniques; computation of the sampled-data control laws, and compensation techniques are applied to reduce the influence of the flexible part on the control system design. An idealized test vehicle subject to a variety of control laws was simulated. The improvements obtained by using a sampled-data scheme with an extended control are evident from the results of the simulations.

N87-25360# Technische Hochschule, Darmstadt (West Germany). Inst. fuer Mechanik II.

## ACTIVE VIBRATION DAMPING OF FLEXIBLE STRUCTURES USING THE TRAVELING WAVE APPROACH

P. HAGEDORN and J. T. SCHMIDT In ESA Proceedings of the Second International Symposium on Spacecraft Flight Dynamics p 47-52 Dec. 1986 Sponsored by the Stiftung Volkswagenwerk Avail: NTIS HC A22/MF A01

A traveling wave approach for the vibration control of networks of slender flexible structural components is presented. The performance of the resulting controller is evaluated and compared with a classical modal controller using a simple model of a prestressed string. Both controllers are tested in numerical simulations. The traveling wave approach is demonstrated to have significant advantages. In particular, it is insensitive to a change in system boundary conditions.

**N87-25395**# Politecnico di Milano (Italy). Dipt. Ingegneria Aerospaziale.

## AUTOMATIC DOCKING MANEUVER AND ATTITUDE CONTROL S YSTEM

AMALIA ERCOLI FINZI and F. VENDITTI In ESA Proceedings of the Second International Symposium on Spacecraft Flight Dynamics p 321-326 Dec. 1986

Avail: NTIS HC A22/MF A01

The interaction between the automatic docking maneuver and the attitude dynamics of the involved spacecraft is analyzed, as far as the docking maneuver behavior is concerned. Three different docking concepts are investigated by dedicated computer dynamics involved the programme.

simulation programs. The simulations consider rigid bodies and the presence of a flexible element between the docking port and the main body on one spacecraft; and with the docking port axis on each vehicle aligned with the center of mass and with large arms with respect to it. The need for proper attitude control systems is established; the importance of energy dissipation sources is shown.

## N87-25801\*# Control Dynamics Co., Huntsville, Ala. CONTACT DYNAMICS MATH MODEL Interim Report

JOHN R. GLAESE and PATRICK A. TOBBE Apr. 1986 95 p (Contract NAS8-36570)

(NASA-CR-179147; NÁS 1.26:179147) Avail: NTIS HC A05/MF A01 CSCL 09B

The Space Station Mechanism Test Bed consists of a hydraulically driven, computer controlled six degree of freedom (DOF) motion system with which docking, berthing, and other mechanisms can be evaluated. Measured contact forces and moments are provided to the simulation host computer to enable representation of orbital contact dynamics. This report describes

the development of a generalized math model which represents the relative motion between two rigid orbiting vehicles. The model allows motion in six DOF for each body, with no vehicle size limitation. The rotational and translational equations of motion are derived. The method used to transform the forces and moments from the sensor location to the vehicles' centers of mass is also explained. Two math models of docking mechanisms, a simple translational spring and the Remote Manipulator System end effector, are presented along with simulation results. The translational spring model is used in an attempt to verify the simulation with compensated hardware in the loop results.

N87-25805# Massachusetts Inst. of Tech., Cambridge. Space Systems Lab.

DEVELOPMENT OF INTELLIGENT STRUCTURES USING FINITE CONTROL ELEMENTS IN A HIERARCHIC AND DISTRIBUTED CONTROL SYSTEM Final Report, 15 May 1985 - 14 Jan. 1986

DAVID W. MILLER, BENJAMIN A. WARD, EDWARD F. CRAWLEY, and WILLIAM WIDNALL 12 Jan. 1987 324 p (Contract F49620-84-K-0010)

(AD-A179711; MIT-SSL-1-87; AFOSR-87-0560TR) Avail: NTIS HC A14/MF A01 CSCL 22B

Conclusions are drawn from the theoretical optimization of inertial reaction devices. Three different optimization procedures yielded almost identical absorber designs providing confidence in the tuning process. The optimal passive components of the control actuator were found to be equal to those of the optimal absorber. This allows passive damping to be added without significant mass penalty. When using an inertial device to increase damping in several modes, it is desirable to tune the frequency of the device to the lowest mode and adjust the damping accordingly. Experimentally, an inertial reaction device was used effectively as both a passive vibration absorber and a control actuator, passively tuned as an absorber, verifying the results of the tuning analysis that stated that passive tuning compliments active control. This dual purpose device resulted in a mass savings, increased modal controllability, and reduced target mode disturbance transmission. Additional passive damping increases gain margin for feedback systems that are conditionally stable and allows a form of passive damping enhancement in the event of control system failure. These space realizable experiments were found to be important in determining performance limitations due to instrumentation instabilities, friction in relative motion actuators, and actuator saturation at low frequencies. Uniformity in the positive definite, dual feedback matrix allowed better performance before the onset of instrumentation. GRA

Howard Univ., Washington, D. C. Dept. of Mechanical Engineering.

MINIMUM TIME ATTITUDE SLEWING MANEUVERS OF A

RIGID SPACECRAFT

FEIYUE LI and PETER M. BAINUM 1987 13 p Proposed for presentation at the AIAA 26th Aerospace Sciences Meeting, Reno, Nev., 11-14 Jan. 1988

(Contract NSG-1414)

(NASA-CR-181130; NAS 1.26:181130) Avail: NTIS HC A02/MF A01 CSCL 01C

The problems of large-angle attitude maneuvers of a spacecraft have gained much consideration in recent years. The configurations of the spacecraft considered are: completely rigid, a combination of rigid and flexible parts, or gyrostat-type systems. The performance indices usually include minimum torque integration, power criterion, and frequency-shaped cost functionals. The minimum time slewing problem of a rigid spacecraft was examined. Optimal control theory (Maximum Principal) was applied to the slewing motion of a general rigid spacecraft. Control torque about all three axes was computed. The equations for the system are composed of the Euler dynamical equations in the spacecraft body axes and the quaternion kinematical equation. By introducing the costates for the quaternion and the angular velocity, the Hamiltonian of the system can be formed and the optimal control obtained. Finally the methods are applied to the SCOLE slewing

motion. The control variables include three control moments on the Shuttle and two control forces on the reflector. Numerical results are discussed.

Texas A&M Univ., College Station. Dept. of N87-26700\*# Mechanical Engineering.

#### **ACTIVE VIBRATION CONTROL IN MICROGRAVITY ENVIRONMENT**

CARL H. GERHOLD In NASA. Lyndon B. Johnson Space Center, National Aeronautics and Space Administration (NASA)/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1986, Volume 1 29 p Jun. 1987
Avail: NTIS HC A16/MF A01 CSCL 05A

The low gravity environment of the space station is suitable for experiments or manufacturing processes which require near zero gravity. An experiment was fabricated to test the validity of the active control process and to verify the flow and control parameters identified in a theoretical model. Zero gravity is approximated in the horizontal plane using a low friction air bearing table. An analog control system was designed to activate calibrated air jets when displacement of the test mass is sensed. The experiment demonstrates that an air jet control system introduces an effective damping factor to control oscillatory response. The amount of damping as well as the flow parameters, such as pressure drop across the valve and flow rate of air, are verified by the analytical model.

#### N87-26966# Naval Postgraduate School, Monterey, Calif. DYNAMIC ANALYSIS OF THE FLEXIBLE BOOM IN THE N-ROSS SATELLITE M.S. Thesis

CHOONG S. KANG Mar. 1987 149 p (AD-A181488) Avail: NTIS HC A07/MF A01 CSCL 22A

Accurate ocean data is essential for successful fleet operation. The N-ROSS Satellite, which is being developed for this mission, will carry a Low Frequency Microwave Radiometer (LFMR). The LFMR consists of large flexible reflector and boom and spins at 15 r.p.m. The effects of the flexibility of the boom, the spin-up procedure and the structural damping on the pointing error of the LFMR are investigated by performing the dynamic simulation using the Dynamic Simulation Language. Two cases of boom material, aluminum alloy and the graphite/epoxy composite material, are analyzed and the results are compared. The simulation and analysis results are presented in graphical forms. Author (GRA)

### N87-26970 Virginia Univ., Charlottesville. THEORY AND APPLICATION OF LINEAR SERVO DAMPERS FOR LARGE SCALE SPACE STRUCTURES Ph.D. Thesis

MICHAEL FREDERICK MALLETTE 1986 244 p Avail: Univ. Microfilms Order No. DA8705681

An investigation was made of control laws of several different servo control circuits for use in damping the vibrations of large scale space structures. A proof-mass type, structure-borne displacement device was tested as a linear servo actuator that is a component of digital control systems. These systems are hardware implementations of certain mathematical models of governing equations that show higher damping figures of merit for certain control circuits in regard to stability and response. The result was a general approach to removal of structural energy from the standpoint of design criterion that includes control law shaping predicted from open loop design, frequency limitations, and selectability of integral exponents as gain values. The critical elements in the development of the damper are the electronic digital signal processor and the associated software used to boot-strap the system up to the final Z-80 microprocessor ground based simulator, and the nearly pure iron pole pieces for the toroidal magnetic field containment into which is coupled a solenoid coil to produce control forces. Dissert. Abstr.

N87-27704\*# Virginia Univ., Charlottesville. Dept. of Mechanical and Aerospace Engineering.

DIGITAL CONTROL SYSTEM FOR SPACE STRUCTURE **DAMPERS Annual Report** 

J. K. HAVILAND Sep. 1985 96 p

(Contract NAG1-349)

(NASA-CR-181253; ŃAS 1.26:181253; UVA/528224-MAE86-105) Avail: NTIS HC A02/MF A01 CSCL 22B

A digital controller was developed using an SKD-51 System Design Kit, which incorporates an 8031 microcontroller. The necessary interfaces were installed in the wire wrap area of the SKD-51 and a pulse width modulator was developed to drive the coil of the actuator. Also, control equations were developed, using floating-point arithmetic. The design of the digital control system is emphasized, and it is shown that, provided certain rules are followed, an adequate design can be achieved. It is recommended that the so-called w-plane design method be used, and that the time elapsed before output of the up-dated coil-force signal be kept as small as possible. However, the cycle time for the controller should be watched carefully, because very small values for this time can lead to digital noise.

N87-27706# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Space Flight Dynamics Section.

STUDY ON INVESTIGATION OF THE ATTITUDE CONTROL OF LARGE FLEXIBLE SPACECRAFT. PHASE 1, VOLUME 1: TECHNICAL REPORT Final Report

G. HEIMBOLD, comp., TH. LANGE, comp., B. SCHAEFER, R. STAPF, H. ROTH, comp., and G. THIEME, comp. (Dornier-Werke G.m.b.H., Friedrichshafen, West Germany) Paris, France ESA Feb. 1984 220 p

(Contract ESTEC-5310/82-NL-BI)

(ESA-CR(P)-2361-VOL-1; ETN-87-90462) Avail: NTIS HC A10/MF A01

Different techniques of attitude and vibration control were applied to structural dynamic models, representative of large flexible spacecraft. The high order systems are reduced to tractable design models using different order reduction methods. A two staged controller design was applied, including sensor/actuator positioning, low authority control for structural damping augmentation, and superimposed high authority control. Fundamental problems to be studied in a laboratory experiment were derived. A test structure represented by a rectangular flexible plate suspended by wires is proposed. The test procedure envisaged includes an ideal approach with respect to the peripheral hardware, and a realistic test where specific performance limitations can be included.

N87-27707# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Space Flight Dynamics Section.

STUDY ON INVESTIGATION OF THE ATTITUDE CONTROL OF LARGE FLEXIBLE SPACECRAFT. PHASE 2, VOLUME 1: EXECUTIVE SUMMARY Final Report

G. HEIMBOLD, H. HOLZACH, TH. LANGE, comp., B. SCHAEFER, R. STAPF, G. THIEME, and N. DUSKE (Dornier-Werke G.m.b.H., Friedrichshafen, West Germany) Paris, France ESA Mar. 1985 55 p

(Contract ESTEC-5310/82-NL-BI)

(ESA-CR(P)-2361-VOL-1; ETN-87-90463) Avail: NTIS HC A04/MF A01

The hardware, experimental and theoretical modeling of the test element, and development and implementation of the controller software for large flexible spacecraft model simulation are described. Based on a finite element method structural model, confirmed by the experimental results, different sensor and actuator positions are derived. For selected configurations, active vibration and attitude controller design is performed. The feasibility of the approaches is proved by a computer performance simulation. The implementation of control laws is realized by an array processor real time routine. The experiments to be performed are summarized.

N87-27708# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). STUDY ON THE INVESTIGATION OF THE ATTITUDE CONTROL OF LARGE FLEXIBLE SPACECRAFT. PHASE 2, VOLUME 2: TECHNICAL REPORT Final Report

Paris, France ESA 1986 267 p (Contract ESTEC-5310/82-NL-BI) (ESA-CR(P)-2361-VOL-2; ETN-87-90464) Avail: NTIS HC A12/MF A01

The hardware, experimental and theoretical modeling of the test element, and development and implementation of the controller software for large flexible spacecraft model simulation are described. Based on a finite element method structural model, confirmed by the experimental results, different sensor and actuator positions are derived. For selected configurations, active vibration and attitude controller design is performed. The feasibility of the approaches is proved by a computer performance simulation. The implementation of control laws is realized by an array processor real time routine. The experiments to be performed are summarized.

N87-27709# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Space Flight Dynamics Section.

STUDY ON INVESTIGATION OF THE ATTITUDE CONTROL OF LARGE FLEXIBLE SPACECRAFT, PHASE 3 Final Report

G. HEIMBOLD, TH. LANGE, comp., N. DUSKE, and G. THIEME Paris, France ESA Oct. 1986 207 p (Contract ESTEC-5310/82-NL-BI)

(ESA-CR(P)-2361-VOL-4; ETN-87-90465) Avail: NTIS HC A10/MF A01

A large flexible spacecraft (LFS) was simulated by a plate suspended from wires. Results revealed constraints, which were not predicted, so the controller was redesigned, to give reduced gain configurations, which the laboratory experience showed feasible. The first test results exhibit considerable discrepancies with respect to the theoretical predictions. A laboratory reference model was developed for theoretical performance prediction. Applying this to the tests using the updated controller design, satisfactory agreement with the test results is achieved. The modeling uncertainty has severe consequences with respect to LFS controller design, where usually the aspect is often considered not to play such an important role. It is concluded that the controller design approaches must be checked and possibly developed to end up at feasible designs for space applications.

N87-27712\*# Howard Univ., Washington, D. C. Dept. of Mechanical Engineering.

THE DYNAMICS AND CONTROL OF LARGE FLEXIBLE SPACE STRUCTURES X, PART 1 Final Report

PETER M. BAINUM, A. S. S. R. REDDY, FEIYUE LI, and CHEICK M. DIARRA Aug. 1987 72 p (Contract NSG-1414)

(NASA-CR-181287; NAS 1.26:181287) Avail: NTIS HC A04/MF A01 CSCL 22B

The effect of delay in the control system input on the stability of a continuously acting controller which is designed without considering the delay is studied. The stability analysis of a second order plant is studied analytically and verified numerically. For this example it is found that the system becomes unstable for a delay which is equivalent to only 16 percent of its natural period of motion. It is also observed that even a small amount of natural damping in the system can increase the amount of delay that can be tolerated before the onset of instability. The delay problem is formulated in the discrete time domain and an analysis procedure suggested. The maximum principle from optimal control theory is applied to minimize the time required for the slewing of a general rigid spacecraft. The slewing motion need not be restricted to a single axis maneuver. The minimum slewing time is calculated based on a quasi-linearization algorithm for the resulting two point boundary value problem. Numerical examples based on the rigidized in-orbit model of the SCOLE also include the more general reflector line-of-sight slewing maneuvers. Author

N87-29162\*# National Aeronautics and Space Administration.
Goddard Space Flight Center, Greenbelt, Md.
USER INTERFACE AND PAYLOAD COMMAND AND CONTROL

/n NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, Volume 2 10 p Aug. 1985
Avail: NTIS HC A17/MF A01 CSCL 09B

Two tasks comprise this overall effort. The first is concerned with developing a modular, machine independent workstation design, science operations interface language and interaction techniques. Design concepts and prototype demonstration of a state of the art prototype workstation are to be based on defining user requirements by determining user interface modes, reflecting needs in space and on ground. The second task aims at generating a command and control system design concept for supporting telescience - a concept for independent science user operations within an operations envelope.

N87-29713\*# Catholic Univ. of America, Washington, D.C. Dept. of Mechanical Engineering.

EFFECT OF BONDING ON THE PERFORMANCE OF A PIEZOACTUATOR-BASED ACTIVE CONTROL SYSTEM

A. BAZ and S. POH 28 Oct. 1987 36 p (Contract NAG5-520; NAG5-749)

(NASA-CR-181414; NAS 1.26:181414) Avail: NTIS HC A03/MF A01 CSCL 13H

The utilization of piezoelectric actuators in controlling the structural vibrations of flexible beams is studied. A Modified Independent Modal Space Control (MIMSC) method is devised to select the optimal location, control gains and excitation voltage of the piezoelectric actuators in a way that would minimize the amplitudes of vibrations of beams to which these actuators are bonded, as well as the input control energy necessary to suppress these vibrations. The presented method accounts for the effects that the piezoelectric actuators and the bonding layers have on changing the elastic and inertial properties of the flexible beams. Numerical examples are presented to illustrate the application of the MIMSC method and to demonstrate the effect of the physical and geometrical properties of the bonding layer on the dynamic performance of the actively controlled beams. The obtained results emphasize the importance of the devised method in designing more realistic active control systems for flexible beams, in particular, and large flexible structures in general.

## N87-29933\*# Oak Ridge National Lab., Tenn. APPLICATION OF ADVANCED FLYWHEEL TECHNOLOGY FOR ENERGY STORAGE ON SPACE STATION

MITCHELL OLSZEWSKI *In* NASA-Lewis Research Center, Space Electrochemical Research and Technology (SERT) p 147-156 Sep. 1987 Previously announced as N87-24028 (Contract DE-AC05-84OR-21400)

Avail: NTIS HC A16/MF A01 CSCL 10C

In space power applications where solar inputs are the primary thermal source, energy storage is necessary to provide a continuous power supply during the eclipse portion of the orbit. Because of their potentially high storage density, flywheels are being considered for use as the storage system on the proposed orbiting space station. During the past several years, graphite fiber technology has advanced, leading to significant gains in flywheel storage density. Use of these improved fibers in experimental flywheel rims has resulted in ultimate storage densities of 878 kJ/kg. With these high strength graphite fibers, operational storage densities for flywheel storage modules applicable to the space station power storage could reach 200 kJ/kg. This module would also be volumetrically efficient occupying only about 1 cu m. Because the size and mass of the flywheel storage module are controlled by the storage density, improvements in fiber strength can have a significant impact on these values. With the improvements anticipated within the next five years, operational storage density on the order of 325 kJ/kg may be possible for the flywheel module. Author

#### 07

#### **POWER**

Includes descriptions of analyses, systems, and trade studies of electric power generation, storage, conditioning and distribution.

#### A87-32306

## A TWO-DIMENSIONAL NUMERICAL HEAT TRANSFER MODEL FOR A SOLAR PROPULSION SYSTEM

D. P. MILLER and J. R. OSBORN (Purdue University, West Lafayette, IN) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 1. Tokyo, AGNE Publishing, Inc., 1986, p. 231-236. refs

A two-dimensional numerical heat transfer model which considered the interaction of conduction, convection and radiation transport mechanisms, was developed for the investigation of the design of an advanced solar thruster. Radiation effects included the scattering, absorption and emisive characteristics of the particle bed. The governing equations were solved using an implicit finite difference method of solution. The flow and temperature distributions are shown computed in the solar absorption chamber. The performance was computed from the temperature distributions and comparisons shown between the present analysis and one-dimensional results. The efficiency of the absorber was predicted for various geometric considerations and compared to the one-dimensional predictions. Results are summarized for a range of parameters.

## A87-32578 POWER MANAGEMENT EQUIPMENT FOR SPACE APPLICATIONS

W. W. BILLINGS, D. A. FOX, and R. G. WAGONER (Westinghouse Electric Corp., Electrical Systems Div., Lima, OH) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 13-16, 1986. 12 p. (SAE PAPER 861621)

The electric power management system on the Space Station will require a complete spectrum of switchgear, power controllers, remote controlled circuit breakers, and conversion equipment. This paper describes some of the AC and DC equipment currently being developed for potential Space Station application. The AC equipment includes High Power Switchgear with 12 switches rated at 440 Vac, 34 Amps; Remote Power Controllers with 2 poles rated at 115 Vac, 43 Amps; three phase Remote Controlled Circuit Breakers rated at 440 Vac, 43 Amps; and a Remote Controlled Switch rated at 115 Vac, 50 Amps. The DC equipment includes a two pole Remote Power Controller rated at 150 Vdc, 40 Amps and a Remote Controlled Circuit Breaker rated at 150 Vdc, 33 Amps. The conversion equipment consists of a 25 kW, 150 Vdc to 440 Vac converter. Distribution equipment being developed includes a 15 kW, 440 Vac to 115 Vac Isolation Transformer and a 5 kW, 440 Vac to 150 Vdc TR Unit. Most of this equipment is designed to allow connection to a Power System Controller through a MIL-STD-1553B Data Bus. The Data Bus provides a pathway for control and status data to and from the equipment and allows reporting of system loads and voltages via built-in monitoring Author circuits.

#### A87-32579

## AN INTEGRATED ANALYTIC TOOL AND KNOWLEDGE-BASED SYSTEM APPROACH TO AEROSPACE ELECTRIC POWER SYSTEM CONTROL

WILLIAM R. OWENS, ERIC HENDERSON, and KAPAL GANDIKOTA (Sundstrand Corp., Rockford, IL) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 13-16, 1986. 10 p. refs (SAE PAPER 861622)

Future aerospace electric power systems require new control methods because of increasing power system complexity, demands

for power system management, greater system size and heightened reliability requirements. To meet these requirements, a combination of electric power system analytic tools and knowledge-based systems is proposed. The continual improvement in microelectronic performance has made it possible to envision the application of sophisticated electric power system analysis tools to aerospace vehicles. These tools have been successfully used in the measurement and control of large terrestrial electric power systems. Among these tools is state estimation which has three main benefits. The estimator builds a reliable database for the system structure and states. Security assessment and contingency evaluation also require a state estimator. Finally, the estimator will, combined with modern control theory, improve power system control and stability. Bad data detection as an adjunct to state estimation identifies defective sensors and communications channels. Validated data from the analytic tools is supplied to a number of knowledge-based systems. These systems will be responsible for the control, protection, and optimization of the electric power system.

A87-32747\* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SOLAR ARRAY FLIGHT DYNAMIC EXPERIMENT

RICHARD W. SCHOCK (NASA, Marshall Space Flight Center, Huntsville, AL) IN: Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 . San Diego, CA, Univelt, Inc., 1986, p. 351-365. Previously announced in STAR as N87-12581. (AAS PAPER 86-050)

The purpose of the Solar Array Flight Dynamic Experiment (SAFDE) is to demonstrate the feasibility of on-orbit measurement and ground processing of large space structures dynamic characteristics. Test definition or verification provides the dynamic characteristic accuracy required for control systems use. An illumination/measurement system was developed to fly on Space Shuttle flight STS-31D. The system was designed to dynamically evaluate a large solar array called the Solar Array Flight Experiment (SAFE) that had been scheduled for this flight. The SAFDE system consisted of a set of laser diode illuminators, retroreflective targets. an intelligent star tracker receiver and the associated equipment to power, condition, and record the results. In six tests on STS-41D, data was successfully acquired from 18 retroreflector targets and ground processed, post flight, to define the solar array's dynamic characteristic. The flight experiment proved the viability of on-orbit test definition of large space structures dynamic characteristics. Future large space structures controllability should be greatly enhanced by this capability.

A87-33787\* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

#### ADVANCED TECHNOLOGY FOR EXTENDED ENDURANCE **ALKALINE FUEL CELLS**

D. W. SHEIBLEY (NASA, Lewis Research Center, Cleveland, OH) and R. A. MARTIN (International Fuel Cells Corp., South Windsor, CT) IN: Progress in batteries and solar cells. Volume 6. Cleveland, OH, JEC Press, Inc., 1987, p. 155-158.

Advanced components have been developed for alkaline fuel cells with a view to the satisfaction of NASA Space Station design requirements for extended endurance. The components include a platinum-on-carbon catalyst anode, a potassium titanate-bonded electrolyte matrix, a lightweight graphite electrolyte reservoir plate, a gold-plated nickel-perforated foil electrode substrate, polyphenylene sulfide cell edge frame material, and a nonmagnesium cooler concept. When incorporated into the alkaline fuel cell unit, these components are expected to yield regenerative operation in a low earth orbit Space Station with a design life greater than 5 years.

#### A87-35799

THE SYNTHESIS OF THE POWER TRANSMISSION CHANNEL FOR A SATELLITE SOLAR POWER STATION [K VOPROSU O SINTEZE TRAKTA PEREDACHI ENERGII SOLNECHNOI KOSMICHESKOI ELEKTROSTANTSII /SKES/]

V. A. VANKE, S. K. LESOMA, and A. V. RACHNIKOV Radiotekhnika i Elektronika (ISSN 0033-8494), vol. 32, March 1987, p. 655-658. In Russian. refs

The problem of sidelobe reduction for the microwave power transmission channel of a satellite solar power station is considered. Discrete amplitude distributions of electric field strength with respect to the radius of the transmitting antenna are plotted which provide for sidelobe levels not greater than 0.13 microW/sq cm and not greater than 5 microW/sq cm. It is shown that the sidelobe level can be reduced to below the EMC standard in the case of amplitude and radius fluctuations of the discrete amplitude distribution with a normalized rms error not exceeding 1 percent and a rms phase error not exceeding 0.5.

A87-36913\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPACE STATION 20-KHZ POWER MANAGEMENT AND

### DISTRIBUTION SYSTEM

IRVING G. HANSEN and GALE R. SUNDBERG (NASA Lewis Research Center, Cleveland, OH) IN: PESC '86; Annual Power Electronics Specialists Conference, 17th, Vancouver, Canada, June 23-27, 1986, Record . New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 676-683. Previously announced in STAR as N86-24747. refs

During the conceptual design phase a 20-kHz power distribution system was selected as the reference for the Space Station. The system is single-phase 400 VRMS, with a sinusoidal wave form. The initial user power level will be 75 kW with growth to 300 kW. high-frequency system selection was based upon considerations of efficiency, weight, safety, ease of control, interface with computers, and ease of paralleling for growth. Each of these aspects will be discussed as well as the associated trade-offs involved. An advanced development program has been instituted to accelerate the maturation of the high-frequency system. Some technical aspects of the advanced development will be discussed.

#### A87-36944

**ERATO ORBITAL TRANSFER VEHICLE WITH ELECTRONUCLEAR POWER STUDY OF THE ASSOCIATED ELECTRONUCLEAR GENERATOR [REMORQUEUR ELECTRONUCLEAIRE SPATIAL ERATO - ETUDE DU GENERATEUR ELECTRONUCLEAIRE ASSOCIE**]

CLAUDE POHER (CNES, Paris, France) and JEAN DELAPLACE (CEA, Paris, France) L'Aeronautique et l'As 0001-9275), no. 120, 1986, p. 58-61. In French. L'Aeronautique et l'Astronautique (ISSN

Characteristics of the several-hundred-kilowatt electronuclear generator projected for the ERATO orbital transfer vehicle (OTV) for the period past 2005 are discussed. It is suggested that such generators will be 2-3 times lighter than solar generators of comparable power, and that the ERATO OTV will be capable of transferring heavy payloads from a low orbit to a geostationary orbit at a much lower cost than possible with the usual chemical processes. The projected electronuclear generators will be sufficiently protected for military space applications, and their development will require the usage of high-temperature (1200 C) material technologies.

National Aeronautics and Space Administration. A87-37291\*# Lyndon B. Johnson Space Center, Houston, Tex.

#### MANNED SPACECRAFT ELECTRICAL POWER SYSTEMS

WILLIAM E. SIMON (NASA, Johnson Space Center, Houston, TX) and DONALD L. NORED (NASA, Lewis Research Center, Cleveland, OH) IEEE, Proceedings (ISSN 0018-9219), vol. 75, March 1987, p. 277-307. refs

A brief history of the development of electrical power systems from the earliest manned space flights illustrates a natural trend toward a growth of electrical power requirements and operational lifetimes with each succeeding space program. A review of the design philosophy and development experience associated with the Space Shuttle Orbiter electrical power system is presented, beginning with the state of technology at the conclusion of the Apollo Program. A discussion of prototype, verification, and qualification hardware is included, and several design improvements following the first Orbiter flight are described. The problems encountered, the scientific and engineering approaches used to meet the technological challenges, and the results obtained are stressed. Major technology barriers and their solutions are discussed, and a brief Orbiter flight experience summary of early Space Shuttle missions is included. A description of projected Space Station power requirements and candidate system concepts which could satisfy these anticipated needs is presented. Significant challenges different from Space Shuttle, innovative concepts and ideas, and station growth considerations are discussed. The Phase B Advanced Development hardware program is summarized and a status of Phase B preliminary tradeoff studies is presented.

#### DEVELOPMENT OF THE ELECTRICAL POWER SUBSYSTEM FOR THE ELECTRIC PROPULSION EXPERIMENT ONBOARD THE SPACE FLYER UNIT (SFU)

Y. KUNII, T. MORIAI, H. ŠASÁKI, T. OKAMURA, H. HARADA (Mitsubishi Electric Corp., Kamakura, Japan) et al. AIAA, DGLR, and JSASS, International Electric Propulsion Conference, 19th, Colorado Springs, CO, May 11-13, 1987. 8 p. refs (AIAA PAPER 87-1040)

Bread Board Model of a few kW class electrical power subsystem is being developed for the Electric Propulsion Experiment (EPEX), which is a space experiment program for a quasi-steady MPD thruster system. EPEX is planned to be tested on a Japanese free flying platform, which is planned to be operational in the 1990s. A one-million-cycle endurance test was carried out from December 1985 to January 1986 with a 1-kW-class pulse forming network (PFN) using improved plastic film capacitors of reduced weight. The test was accomplished in a vacuum chamber with arc discharges. The BBM PFN was designed and manufactured with the results of the one-million-cycle endurance test, and a ten-million cycle endurance test is planned starting October 1987.

A87-39629#

#### DEVELOPMENT OF CONTROL AND MONITOR SUBSYSTEM FOR ELECTRIC PROPULSION EXPERIMENT ONBOARD **SPACE FLYER UNIT (SFU)**

Y. KUNII, T. MORIAÌ, T. OKAMURA, T. YOSHIDA, K. IJICHI (Mitsubishi Electric Corp., Kamakura, Japan) et al. AIAA, DGLR, and JSASS, International Electric Propulsion Conference, 19th, Colorado Springs, CO, May 11-13, 1987. 6 p. (AIAA PAPER 87-1041)

The Electric Propulsion Experiment (EPEX) is a Japanese space experiment program for the quasi-steady MPD thruster system. The EPEX is planned to be tested on a Japanese free flying platform and launched in the 1990s. The requirements for the control and monitor subsystem of EPEX were discussed and the conceptual design was performed. Since 1983, repetitive charging and discharging operations for the ground endurance tests were conducted with the sequence controllers, which were made of hard wired logic circuits. Photo transistors were found to be preferable for recognition of the occurance of arc discharge and the normal termination of the repetitive cycle. For the EPEX, because of the limited capability of the platform bus system, the autonomous operation of the experiment is required in addition to the simple sequence control. The autonomous operation with a microcomputer system will be tested in the next ground endurance test to be started in October 1987. Author

A87-39735

#### PERMANENT-MAGNET LINEAR ALTERNATORS. I -FUNDAMENTAL EQUATIONS. II - DESIGN GUIDELINES

I. BOLDEA (Institutul Politehnic, Timisoara, Rumania) and S. A. NASAR (Kentucky, University, Lexington) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. AES-23, Jan. 1987, p. 73-82. refs

(Contract NSF ECS-83-14238; NSF INT-84-08315)

The general equations of permanent-magnet heteropolar

three-phase and single-phase linear alternators, powered by free-piston Stirling engines, are presented, with application to space power stations and domestic applications including solar power plants. The equations are applied to no-load and short-circuit conditions, illustrating the end-effect caused by the speed-reversal process. In the second part, basic design guidelines for a three-phase tubular linear alternator are given, and the procedure is demonstrated with the numerical example of the design of a 25-kVA, 14.4-m/s, 120/220-V, 60-Hz alternator.

National Aeronautics and Space Administration. A87-40378\*# Lewis Research Center, Cleveland, Ohio.

20 KHZ SPACE STATION POWER SYSTEM

IRVING G. HANSEN and FREDRICK J. WOLFF (NASA, Lewis Research Center, Cleveland, OH) IN: EASCON '86; Proceedings of the Nineteenth Annual Electronics and Aerospace Systems Conference, Washington, DC, Sept. 8-10, 1986 . New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 251-255.

Previously announced in STAR as N86-28122. refs

The Space Station represents the next major U.S. commitment in space. The efficient delivery of power to multiple user loads is key to that success. In 1969, NASA Lewis Research Center began a series of studies with component and circuit developments that led to the high frequency bi-directional, four quadrant resonant driven converter. Additional studies and subsequent developments into the early 1980's have shown how the high frequency ac power system could provide overall advantages to many aerospace power systems. Because of its wide versatility, it also has outstanding advantages for the Space Station Program and its wide range of users. High frequency ac power provides higher efficiency, lower cost, and improved safety. The 20 kHz power system has exceptional flexibility, is inherently user friendly, and is compatible with all types of energy sources - photovoltaic, solar dynamic, rotating machines or nuclear Lewis distribution system testbed. The testbed demonstrates flexibility, versatility, and transparency to user technology as well as high efficiency, low Author mass, and reduced volume.

Jet Propulsion Lab., California Inst. of Tech., A87-41145\*# Pasadena.

### NUCLEAR REACTOR POWER FOR AN ELECTRICALLY

POWERED ORBITAL TRANSFER VEHICLE
L. JAFFE, R. BEATTY, P. BHANDARI, E. CHOW, W. DEININGER, R. EWELL, T. FUJITA, M. GROSSMAN, T. KIA, B. NESMITH (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) et al. AIAA, DGLR, and JSASS, International Electric Propulsion Conference, 19th, Colorado Springs, CO, May 11-13, 1987. 7 p. DOD-DOE-NASA-sponsored research. (AIAA PAPER 87-1102)

To help determine the systems requirements for a 300-kWe space nuclear reactor power system, a mission and spacecraft have been examined which utilize electric propulsion and this nuclear reactor power for multiple transfers of cargo between low earth orbit (LEO) and geosynchronous earth orbit (GEO). A propulsion system employing ion thrusters and xenon propellant was selected. Propellant and thrusters are replaced after each sortie to GEO. The mass of the Orbital Transfer Vehicle (OTV), empty and dry, is 11,000 kg; nominal propellant load is 5000 kg. The OTV operates between a circular orbit at 925 km altitude, 28.5 deg inclination, and GEO. Cargo is brought to the OTV by Shuttle and an Orbital Maneuvering Vehicle (OMV); the OTV then takes it to GEO. The OTV can also bring cargo back from GEO, for transfer by OMV to the Shuttle. OTV propellant is resupplied and the ion thrusters are replaced by the OMV before each trip to GEO. At the end of mission life, the OTV's electric propulsion is used to place it in a heliocentric orbit so that the reactor will not return to earth. The nominal cargo capability to GEO is 6000 kg with a transit time of 120 days; 1350 kg can be transferred in 90 days, and 14,300 kg in 240 days. These capabilities can be considerably increased by using separate Shuttle launches to bring up propellant and cargo, or by changing to mercury propellant.

Author

#### A87-42265#

### SURVEY OF SOLAR-DYNAMIC SPACE POWER - THE STIRLING OPTION

D. ESHUIS (Delft, Technische Hogeschool, Netherlands) ESA Journal (ISSN 0379-2285), vol. 10, no. 4, 1986, p. 343-362. refs

An assessment of the feasibility and implications of a Stirling-cycle space power system is described by looking at various aspects of the system, its subsystems and components, and a reference configuration for preliminary calculations and comparisons is presented. Among the technologies applied would be those of: free-piston Stirling engines, inflatable space-rigidized structures, heat-pipes, and thermal energy storage. It can be concluded that Solar-Dynamic Space Power System development still has a long way to go, but that an increased R&D effort is warranted by the good prospects that the technology shows.

Author

#### A87-43004#

### A TRANSIENT ANALYSIS OF PHASE CHANGE ENERGY STORAGE SYSTEM FOR SOLAR DYNAMIC POWER

D. K. DAROOKA (General Electric Co., Space Div., Philadelphia, PA) AlAA, Thermophysics Conference, 22nd, Honolulu, HI, June 8-10, 1987. 12 p.

(AIAA PAPER 87-1469)

The Phase Change Energy Storage System constitutes a key element of the Solar Dynamic Power System now being considered for the Space Station. The stored energy is provided to the Energy Conversion System during the non-illuminated portion of the orbit. This cyclic nature of the application requires understanding of the transient behavior of the Energy Storage System. A one dimensional thermal model was developed that uses a fixed-grid, implicit finite-difference formulation to handle the transient interface condition between the liquid and solid phases. This model was applied to a conceptual design of solar thermal receiver based on radiative coupling between the thermal energy storage container and the heat exchanger for the working fluid. Transient results indicate that the proposed design concept can meet the Space Station requirements.

#### A87-45363#

## PERFORMANCE OF AN SP-100/PULSED ELECTROTHERMAL THRUSTER ORBIT TRANSFER VEHICLE

R. L. BURTON (GT-Devices, Inc., Alexandria, VA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 23rd, San Diego, CA, June 29-July 2, 1987. 6 p. refs (AIAA PAPER 87-2027)

The performance of the pulsed electrothermal (PET) thruster is evaluated for SP-100-based orbit transfer missions at the 100 kWe level. The PET thruster is a high resistance, high pressure electrothermal discharge coupled to a supersonic, equilibrium flow nozzle. The discharge, which pulses at over 100 Hz, is designed so as to prevent ablation of the thruster components. The thruster efficiency is predicted to be 70 percent using hydrazine propellant at a 1030-second specific impulse and a thrust/power ratio of 0.14 N/kW. System component masses are presented for orbit transfer missions of Delta V = 6 km/s and 1 km/s. System lifetime is discussed for these missions. Liquid hydrogen performance is 78 percent at 2500 seconds for the PET thruster, for missions where cryogenics can be accommodated.

#### A87-48264

### NEW POWER PROCESSOR INTERFACES MMS POWER MODULE OUTPUTS

P. R. K. CHETTY (Fairchild Space Co., Germantown, MD) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. AES-23, May 1987, p. 311-316.

A description of a new power processor to interface the outputs from two or more multimission modular spacecraft (MMS) modular power system (MPS) modules to the spacecraft payload is presented. Also included are an introduction describing the circumstances that led to this power processor, and material concerning analysis results, load programmability, and salient

features, including efficiency and weight aspects. Finally, important input and output electrical characteristics of this processor are summarized.

Author

#### A87-50511#

#### A COMPARISON OF SCHEDULING ALGORITHMS FOR AUTONOMOUS MANAGEMENT OF THE SPACE STATION ELECTRIC ENERGY SYSTEM

DOUGLAS BERMAN and JOHN W. MCCLURE (Charles Stark Draper Laboratory, Inc., Cambridge, MA) IN: AlAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 2. New York, American Institute of Aeronautics and Astronautics, 1987, p. 1007-1016. refs (AlAA PAPER 87-2467)

The scheduling problem associated with the onboard, autonomous management of the Space Station electric energy system, and two solution approaches developed at Draper Laboratory, are examined. The scheduling problem is posed as a constrained combinatorial optimization problem. This formulation takes into account the dynamics and limitations posed by the power generation and storage systems, the various power profiles for the tasks to be scheduled, as well as the different optimization criteria defining desirable schedules. Given this problem definition, solution approaches based on the now popular simulated annealing algorithm and on a multistart algorithm are proposed and contrasted. Following the description of these approaches, experience with these approaches is summarized in a results section.

N87-20584\*# National Aeronautics and Space Administration.

Marshall Space Flight Center, Huntsville, Ala.

#### SAFE/DAE: MODAL TEST IN SPACE

T. E. NESMAN and D. K. REED *In* Shock and Vibration Information Center The Shock and Vibration Bulletin. Part 2: Modal Test and Analysis, Testing Techniques, Machinery Dynamics, Isolation and Damping, Structural Dynamics p 29-36 Aug. 1986
Avail: NTIS HC A10/MF A01 CSCL 22B

In September of 1984, NASA performed a series of experiments on orbit with a large solar wing attached to the Space Shuttle orbiter. These experiments, the Solar Array Flight Experiment (SAFE), mark the first tests of a large space structure in space. Extension, retraction, and dynamic tests had to be performed in space due to the fragility of the solar array. Due to the extendable and retractable design of the solar array, accelerometers and associated wires could not be used; therefore, remote sensing, the Dynamics Augmentation Experiment (DAE), was added to the SAFE program. The DAE uses a remote sensor based on star tracker technology to measure the dynamic response of the solar array. The DAE sensor tracked 18 targets on the solar array during free-decay response to a transient excitation. An overview of the SAFE/DAE is presented, highlighting analysis results from the remotely sensed data. Modal parameter estimates from the remotely sensed data were computed using the complex exponential and polyreference techniques. Author

N87-21153\*# Sverdrup Technology, Inc., Middleburg Heights, Ohio.

### MICROGRAVITY FLUID MANAGEMENT REQUIREMENTS OF ADVANCED SOLAR DYNAMIC POWER SYSTEMS

ROBERT P. MIGRA In NASA. Lewis Research Center Microgravity Fluid Management Symposium p 151-162 Apr. 1987

Avail: NTIS HC A10/MF A01 CSCL 22A

The advanced solar dynamic system (ASDS) program is aimed at developing the technology for highly efficient, lightweight space power systems. The approach is to evaluate Stirling, Brayton and liquid metal Rankine power conversion systems (PCS) over the temperature range of 1025 to 1400K, identify the critical technologies and develop these technologies. Microgravity fluid management technology is required in several areas of this program, namely, thermal energy storage (TES), heat pipe applications and liquid metal, two phase flow Rankine systems. Utilization of the heat of fusion of phase change materials offers potential for smaller, lighter TES systems. The candidate TES

materials exhibit large volume change with the phase change. The heat pipe is an energy dense heat transfer device. A high temperature application may transfer heat from the solar receiver to the PCS working fluid and/or TES. A low temperature application may transfer waste heat from the PCS to the radiator. The liquid metal Rankine PCS requires management of the boiling/condensing process typical of two phase flow systems.

Author

N87-22004\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

## EMC AND POWER QUALITY STANDARDS FOR 20-KHZ POWER DISTRIBUTION

IRVING G. HANSEN 1987 8 p Proposed for presentation at the 22nd Intersociety Energy Conversion Engineering Conference, Philadelphia, Pa., 10-14 Aug. 1987; sponsored by AIAA, ANS, ASME, SAE, IEEE, ACS and AIChE

(NASA-TM-89925; E-3626; NAS 1.15:89925; AIAA-87-9355) Avail: NTIS HC A02/MF A01 CSCL 09C

The Space Station Power Distribution System has been baselined as a sinusoidal single phase, 440 VRMS system. This system has certain unique characteristics directly affecting its application. In particular, existing systematic description and control documents were modified to reflect the high operating frequency. This paper will discuss amendments made on Mil STD 704 (Electrical Power Characteristics), and Mil STD 461-B (Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference). In some cases these amendments reflect changes of several orders of magnitude. Implications and impacts of these changes are discussed.

Author

N87-22174\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

## SELECTION OF HIGH TEMPERATURE THERMAL ENERGY STORAGE MATERIALS FOR ADVANCED SOLAR DYNAMIC SPACE POWER SYSTEMS

DOVIE E. LACY, CAROLYN COLES-HAMILTON, and ALBERT JUHASZ 1987 13 p Proposed for presentation at the 22nd Intersociety Energy Conversion Engineering Conference, Philadelphia, Pa., 10-14 Aug. 1987; sponsored by AIAA, ANS, ASME, SAE, IEEE, ACS and AIChE

(NASA-TM-89886; E-3569; NAS 1.15:89886) Avail: NTIS HC A02/MF A01 CSCL 10B

Under the direction of NASA's Office of Aeronautics and Technology (OAST), the NASA Lewis Research Center has initiated an in-house thermal energy storage program to identify combinations of phase change thermal energy storage media for use with a Brayton and Stirling Advanced Solar Dynamic (ASD) space power system operating between 1070 and 1400 K. A study has been initiated to determine suitable combinations of thermal energy storage (TES) phase change materials (PCM) that result in the smallest and lightest weight ASD power system possible. To date the heats of fusion of several fluoride salt mixtures with melting points greater than 1025 K have been verified experimentally. The study has indicated that these salt systems produce large ASD systems because of their inherent low thermal conductivity and low density. It is desirable to have PCMs with high densities and high thermal conductivities. Therefore, alternate phase change materials based on metallic alloy systems are also being considered as possible TES candidates for future ASD space power systems.

N87-22722\*# National Aeronautics and Space Administration.
Marshall Space Flight Center, Huntsville, Ala.

SOLAR ARRAY FLIGHT DYNAMIC EXPERIMENT

RICHARD W. SCHOCK In its Structural Dynamics and Control Interaction of Flexible Structures p 487-504 Apr. 1987

Avail: NTIS HC A99/MF E03 CSCL 10A

The purpose of the Solar Array Flight Dynamic Experiment (SAFDE) is to demonstrate the feasibility of on-orbit measurement and ground processing of large space structures' dynamic characteristics. Test definition or verification provides the dynamic

characteristic accuracy required for control systems use. An illumination/measurement system was developed to fly on space shuttle flight STS-41D. The system was designed to dynamically evaluate a large solar array called the Solar Array Flight Experiment (SAFE) that had been scheduled for this flight. The SAFDE system consisted of a set of laser diode illuminators, retroreflective targets, an intelligent star tracker receiver and the associated equipment to power, condition, and record the results. In six tests on STS-41D, data was successfully acquired from 18 retroreflector targets and ground processed, post flight, to define the solar array's dynamic characteristic. The flight experiment proved the viability of on-orbit test definition of large space structures dynamic characteristics. Future large space structures controllability should be greatly enhanced by this capability.

N87-22740\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SLEWING CONTROL EXPERIMENT FOR A FLEXIBLE PANEL

JER-NAN JUANG In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 1013-1032 Apr. 1987

Avail: NTIS HC A99/MF E03 CSCL 22B

Technology areas are identified in which better analytical and/or experimental methods are needed to adequately and accurately control the dynamic responses of multibody space platforms such as the space station. A generic space station solar panel is used to experimentally evaluate current control technologies. Active suppression of solar panel vibrations induced by large angle maneuvers is studied with a torque actuator at the root of the solar panel. These active suppression tests will identify the hardware requirements and adequacy of various controller designs.

N87-23028\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

## PERFORMANCE CHARACTERISTICS OF A COMBINATION SOLAR PHOTOVOLTAIC HEAT ENGINE ENERGY CONVERTER

DONALD L. CHUBB 1987 14 p Prepared for presentation at the 22nd Intersociety Energy Conversion Engineering Conference, Philadelphia, Pa. 10-14 Aug. 1987; cosponsored by AIAA, ANS, ASME, SAE, IEEE, ACS, AIChE

(NASA-TM-89908; E-3591; NAS 1.15:89908; AIAA-87-9035) Avail: NTIS HC A02/MF A01 CSCL 10A

A combination solar photovoltaic heat engine converter is proposed. Such a system is suitable for either terrestrial or space power applications. The combination system has a higher efficiency than either the photovoltaic array or the heat engine alone can attain. Advantages in concentrator and radiator area and receiver mass of the photovoltaic heat engine system over a heat-engine-only system are estimated. A mass and area comparison between the proposed space station organic Rankine power system and a combination PV-heat engine system is made. The critical problem for the proposed converter is the necessity for high temperature photovoltaic array operation. Estimates of the required photovoltaic temperature are presented.

N87-23695\*# Rockwell International Corp., Canoga Park, Calif. Rocketdyne Div.

SPACE STATION WP-04 POWER SYSTEM. VOLUME 1: EXECUTIVE SUMMARY Final Study Report

G. J. HALLINAN 19 Jan. 1987 92 p (Contract NAS3-24666)

(NASA-CR-179587-VOL-1; NAS 1.26:179587-VOL-1;

FSR-DR-15-VOL-1) Avail: NTIS HC A05/MF A01 CSCL 14B

Major study activities and results of the phase B study contract for the preliminary design of the space station Electrical Power System (EPS) are summarized. The areas addressed include the general system design, man-tended option, automation and robotics, evolutionary growth, software development environment, advanced development, customer accommodations, operations planning, product assurance, and design and development phase planning. The EPS consists of a combination photovoltaic and

solar dynamic power generation subsystem and a power management and distribution (PMAD) subsystem. System trade studies and costing activities are also summarized.

N87-23696\*# Rockwell International Corp., Canoga Park, Calif. Rocketdyne Div.

SPACE STATION WP-04 POWER SYSTEM. VOLUME 2: STUDY **RESULTS Final Study Report** 

G. J. HALLINAN 19 Jan. 1987 556 p

(Contract NAS3-24666)

(NASA-CR-179587-VOL-2; NAS 1.26:179587-VOL-2;

FSR-DR-15-VOL-2) Avail: NTIS HC A24/MF A01 CSCL 14B

Results of the phase B study contract for the definition of the space station Electric Power System (EPS) are presented in detail along with backup information and supporting data. Systems analysis and trades, preliminary design, advanced development, customer accommodations, operations planning, product assurance, and design and development phase planning are addressed. The station design is a hybrid approach which provides user power of 25 kWe from the photovoltaic subsystem and 50 kWe from the solar dynamic subsystem. The electric power is distributed to users as a utility service; single phase at a frequency of 20 kHz and voltage of 440VAC. The solar array NiH2 batteries of the photovoltaic subsystem are based on commonality to those used on the co-orbiting and solar platforms.

#### N87-24530# Alcatel Thomson Espace, Toulouse (France). ASSESSMENT OF SPACE STATION POWER SYSTEM Final Report

Paris, France ESA Oct. 1986 210 p (Contract ESA-5170/85-NL-AN(SC)) (ATES-AN-86/466; ESA-CR(P)-2355; ETN-87-99889) Avail: NTIS HC A10/MF A01

It is shown that for large power spacecraft exceeding 10 KW user power, the distributed voltage must be a trade-off between mass of power system elements, transmission efficiency, plasma losses, component technology availability, and safety. The optimum voltage is 150 V. Simulation results indicate that the best electrical, mechanical, and thermal performances are available with an unregulated bus power system and the worst ones with the regulated bus concept, the sunlight regulated bus system data being very close to the latter concept. The substandard performance of the regulated bus voltage configuration is explainable by the fact that the simulation software is restricted to the power system platform simulation and does not take into account the important part of the active power distribution (voltage regulators on every user network) which is hidden in the user power profile. In spite of the contradictory results of the configuration evaluation, the regulated bus concept is advocated as power system configuration for the Space Station at 150 V + or - 10%. **ESA** 

N87-24532# Technische Univ., Berlin (West Germany). Inst. fuer Luft- und Raumfahrt.

#### PRELIMINARY ANALYSIS OF A PROTOTYPE SPACE SOLAR POWER SYSTEM

BERND JOHENNING, HEINZ-HERMANN KOELLE, THOMAS ALTMANN, THOMAS DREER, THOMAS ECKARDT, ANDREAS JAIN, OLAF KERINNIS, MICHAEL KRUEGER, MICHAEL MIELKE, and NICOLAUS MILLIN 15 Oct. 1986 35 p In GERMAN: **ENGLISH summary** 

(ILR-MITT-168; ETN-87-99672) Avail: NTIS HC A03/MF A01

The results of a study project on a 500MW space solar power unit are summarized. The analysis concentrated on the assembly process to be carried out in geostationary orbit. The satellite power unit and the required infrastructure (manufacturing plant, habitat, space port, space tugs, etc.) have a total mass of 10,000 metric tons. It is estimated that the assembly of this complex takes 40 months at an average crew of 40 at the assembly site. The logistics support requires 134 flights of a space freighter with a payload of 100 metric tons, and 29 passenger flights. The transition from prototype assembly to large scale manufacturing is discussed.

N87-24533# Technische Hogeschool, Delft (Netherlands). Dept. of Electrical Engineering.

STATUS OF SERIES-RESONANT POWER CONVERSION WITH HIGH INTERNAL FREQUENCIES. SUPPORT IN DEFINITION OF **SPACE STATION POWER INTERFACE** 

J. BENKLAASSENS and JEROEN VANDUIVENBODE France ESA 1986 99 p

(Contract ESA-5170/85-NL-AN(SC))

(ESA-CR(P)-2319; ETN-87-99875) Avail: NTIS HC A05/MF A01 The principles of series-resonant power conversion are reviewed. Optimization of series-resonant converters is discussed. The role the series-resonant converter can play in the power system of the Columbus space station is assessed. Its implementation conversion gives dc conversion practically all the advantages of ac conversion, due to the fact that the series-resonant conversion process is based on the transfer of electric energy by an ac internal waveform.

N87-24838\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

#### EFFECT OF COMPONENT COMPRESSION ON THE INITIAL PERFORMANCE OF AN IPV NICKEL-HYDROGEN CELL

RANDALL F. GAHN 1987 17 p Prepared for presentation at the 22nd Intersociety Energy Conversion Engineering Conference, Philadelphia, Pa., 10-14 Aug. 1987; cosponsored by AIAA, ANS, ASME, SAE, IEEE, ACS, and AICHE

(NASA-TM-100102; E-3590; NAS 1.15:100102; AIAA-87-9257)

Avail: NTIS HC A02/MF A01 CSCL 10C

An experimental method was developed for evaluating the effect of component compression on the charge and discharge voltage characteristics of a 3 1/2 in. diameter boiler plate cell. A standard boiler plate pressure vessel was modified by the addition of a mechanical feedthrough on the bottom of the vessel which permitted different compressions to be applied to the components without disturbing the integrity of the stack. Compression loadings from 0.94 to 27.4 psi were applied by suspending weights from the feedthrough rod. Cell voltages were measured for 0.96-C, 55-min charge and for 1.37-C, 35-min and 2-C, 24-min discharges. An initial change in voltage performance on both charge and discharge as the loading increased was attributed to seating of the components. Subsequent variation of the compression from 2.97 to 27.4 psi caused only minor changes in either the charge or the discharge voltages. Several one month open-circuit voltage stands and 1100 cycles under LEO conditions at the maximum loading have produced no change in performance.

N87-25838\*# National Aeronautics and Space Administration.

### Lewis Research Center, Cleveland, Ohio. NUCLEAR REACTOR POWER FOR A SPACE-BASED RADAR. SP-100 PROJECT

HARVEY BLOOMFIELD, JACK HELLER, LEONARD JAFFE, RICHARD BEATTY, PRADEEP BHANDARI, EDWIN CHOW, WILLIAM DEININGER, RICHARD EWELL, TOSHIO FUJITA, MERLIN GROSSMAN et al. 31 Aug. 1986 176 p Prepared in cooperation with JPL, Pasadena, Calif. and Los Alamos National Lab., N. Mex.

(Contract NAS7-918; DE-Al03-86SF-16013)

(NASA-TM-89295; JPL-PUB-86-47; NAS 1.15:89295) Avail: NTIS HC A09/MF A01 CSCL 18I

A space-based radar mission and spacecraft, using a 300 kWe nuclear reactor power system, has been examined, with emphasis on aspects affecting the power system. The radar antenna is a horizontal planar array, 32 X 64 m. The orbit is at 61 deg, 1088 km. The mass of the antenna with support structure is 42,000 kg; of the nuclear reactor power system, 8,300 kg; of the whole spacecraft about 51,000 kg, necessitating multiple launches and orbital assembly. The assembly orbit is at 57 deg, 400 km, high enough to provide the orbital lifetime needed for orbital assembly. The selected scenario uses six Shuttle launches to bring the spacecraft and a Centaur G upper-stage vehicle to assembly orbit. After assembly, the Centaur places the spacecraft in operational orbit, where it is deployed on radio command, the power system started, and the spacecraft becomes operational. Electric propulsion is an alternative and allows deployment in assembly orbit, but introduces a question of nuclear safety.

N87-26144\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

#### SPACE STATION ELECTRICAL POWER SYSTEM

THOMAS L. LABUS and THOMAS H. COCHRAN 1987 19 p Proposed for presentation at the 38th International Astronautical Federation Congress, Brighton, England, 10-17 Oct. 1987 (NASA-TM-100140; E-3692; NAS 1.15:100140; IAF-87-234) Avail: NTIS HC A02/MF A01 CSCL 22B

The purpose of this paper is to describe the design of the Space Station Electrical Power System. This includes the Photovoltaic and Solar Dynamic Power Modules as well as the Power Management and Distribution System (PMAD). In addition, two programmatic options for developing the Electrical Power System will be presented. One approach is defined as the Enhanced Configuration and represents the results of the Phase B studies conducted by the NASA Lewis Research Center over the last two years. Another option, the Phased Program, represents a more measured approach to reaching about the same capability as the Enhanced Configuration.

 ${\bf N87\text{-}26414^*\#}$  National Aeronautics and Space Administration, Washington, D.C.

### AN OVERVIEW OF PHOTOVOLTAIC APPLICATIONS IN SPACE

ROBERT A. WASEL In NASA. Lewis Research Center, Space Photovoltaic Research and Technology 1986. High Efficiency, Space Environment and Array Technology p 1-7 Jun. 1987 Avail: NTIS HC A16/MF A01 CSCL 10B

An overview is given of the uses of photovoltaic (PV) power in space. The contribution of PV systems on unmanned, low Earth orbit and inner planetary missions is noted. The development of PV technology along the two paths of high efficiency and high power is discussed. The importance of increasing the service life of PV systems is covered.

R.J.F.

## N87-26424\*# Spectrolab, Inc., Sylmar, Calif. DESIGN STUDY OF LARGE AREA 8 CM X 8 CM WRAPTHROUGH CELLS FOR SPACE STATION

GEORGE F. J. GARLICK and DAVID R. LILLINGTON In NASA. Lewis Research Center, Space Photovoltaic Research and Technology 1986. High Efficiency, Space Environment and Array Technology p 87-97 Jun. 1987

Avail: NTIS HC A16/MF A01 CSCL 10B

The design of large area silicon solar cells for the projected NASA space station is discussed. It is based on the NASA specification for the cells which calls for an 8 cm by 8 cm cell of wrapthrough type with gridded back contacts. The beginning of life (BOL) power must be 1.039 watts per cell or larger and maximum end of life (EOL) after 10 years in the prescribed orbit under an equivalent 1MeV electron radiation damage fluence of 5 times 10 to the 13th power e/square cm. On orbit efficiency is to be optimized by a low thermal absorptance goal (thermal alpha) of .63.

N87-26429\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

### ADVANCED PHOTOVOLTAIC SOLAR ARRAY DESIGN ASSESSMENT

PAUL STELLA and JOHN SCOTT-MONCK In NASA. Lewis Research Center, Space Photovoltaic Research and Technology 1986. High Efficiency, Space Environment and Array Technology p 145-150 Jun. 1987

Avail: NTIS HC A16/MF A01 CSCL 10B

The Advanced Photovoltaic Solar Array (APSA) program seeks to bring to flight readiness a solar array that effectively doubles the specific power of the Solar Array Flight Experiment/Solar Electric Propulsion (SAFE/SEP) design that was successfully demonstrated during the Shuttle 41-D mission. APSA is a critical intermediate milestone in the effort to demonstrate solar array

technologies capable of 300 W/kg and 300 W/square m at beginning of life (BOL). It is not unreasonable to anticipate the development of solar array designs capable of 300 W/kg at BOL for operational power levels approx. greater than 25 kW sube. It is also quite reasonable to expect that high performance solar arrays capable of providing at least 200 W/kg at end of life for most orbits now being considered by mission planners will be realized in the next decade.

N87-26447\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

#### SPACE STATION POWER SYSTEM

COSMO R. BARAONA In its Space Photovoltaic Research and Technology 1986. High Efficiency, Space Environment and Array Technology p 321-332 Jun. 1987 Previously announced as N86-32521

Avail: NTIS HC A16/MF A01 CSCL 10B

The major requirements and guidelines that affect the space station configuration and power system are explained. The evolution of the space station power system from the NASA program development-feasibility phase through the current preliminary design phase is described. Several early station concepts are described and linked to the present concept. Trade study selections of photovoltaic system technologies are described in detail. A summary of present solar dynamic and power management and distribution systems is also given.

N87-26452\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

#### HIGH POWER/LARGE AREA PV SYSTEMS

JOSEPH WISE (Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.) and COSMO BARAONA *In its* Space Photovoltaic Research and Technology 1986. High Efficiency, Space Environment and Array Technology p 355-359 Jun. 1987

Avail: NTIS HC A16/MF A01 CSCL 10B

The major photovoltaic power system technology drivers for a wide variety of mission types were ranked. Each technology driver was ranked on a scale of high, medium, or low in terms of importance to each particular mission type. The rankings were then compiled to determine the overall importance of each driver over the entire range of space missions. In each case cost was ranked the highest.

N87-26699\*# Prairie View Agricultural and Mechanical Coll., Tex. Dept. of Electrical Engineering.

## SPACE STATION ELECTRICAL POWER DISTRIBUTION ANALYSIS USING A LOAD FLOW APPROACH

ERVIN M. EMANUEL In NASA. Lyndon B. Johnson Space Center, National Aeronautics and Space Administration (NASA)/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1986, Volume 1 12 p Jun. 1987 Avail: NTIS HC A16/MF A01 CSCL 05A

The space station's electrical power system will evolve and grow in a manner much similar to the present terrestrial electrical power system utilities. The initial baseline reference configuration will contain more than 50 nodes or busses, inverters, transformers, overcurrent protection devices, distribution lines, solar arrays, and/or solar dynamic power generating sources. The system is designed to manage and distribute 75 KW of power single phase or three phase at 20 KHz, and grow to a level of 300 KW steady state, and must be capable of operating at a peak of 450 KW for 5 to 10 min. In order to plan far into the future and keep pace with load growth, a load flow power system analysis approach must be developed and utilized. This method is a well known energy assessment and management tool that is widely used throughout the Electrical Power Utility Industry. The results of a comprehensive evaluation and assessment of an Electrical Distribution System Analysis Program (EDSA) is discussed. Its potential use as an analysis and design tool for the 20 KHz space station electrical power system is addressed.

N87-28186# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

COMPUTER MODELING OF HIGH-VOLTAGE SOLAR ARRAY EXPERIMENT USING THE NASCAP/LEO (NASA CHARGING ANALYZER PROGRAM/LOW EARTH ORBIT) COMPUTER CODE M.S. Thesis

KARL O. REICHL, JR. Jun. 1987 211 p

(AD-A182589; AFIT/GE/ENG/87J-2) Avail: NTIS HC A10/MF A01 CSCL 10B

The relationship between the Interactions Measurement Payload for Shuttle (IMPS) flight experiment and the low Earth orbit plasma environment is discussed. Two interactions (parasitic current loss and electrostatic discharge on the array) may be detrimental to mission effectiveness. They result from the spacecraft's electrical potentials floating relative to plasma ground to achieve a charge flow equilibrium into the spacecraft. The floating potentials were driven by external biases applied to a solar array module of the Photovoltaic Array Space Power (PASP) experiment aboard the IMPS test pallet. The modeling was performed using the NASA Charging Analyzer Program/Low Earth Orbit (NASCAP/LEO) computer code which calculates the potentials and current collection of high-voltage objects in low Earth orbit. Models are developed by specifying the spacecraft, environment, and orbital parameters. Eight IMPS models were developed by varying the array's bias voltage and altering its orientation relative to its motion. The code modeled a typical low Earth equatorial orbit. NASCAP/LEO calculated a wide variety of possible floating potential and current collection scenarios. These varied directly with both the array bias voltage and with the vehicle's orbital orientation.

N87-28188\*# International Fuel Cells Corp., South Windsor, Conn.

DEVELOPMENT OF AN ALKALINE FUEL CELL SUBSYSTEM Final Program Summary Report, 10 Apr. 1986 - 31 Mar. 1987 31 Mar. 1987 94 p

(Contract NAS9-17613)

(NASA-CR-172002; NÁS 1.26:172002) Avail: NTIS HC A05/MF A01 CSCL 10A

A two task program was initiated to develop advanced fuel cell components which could be assembled into an alkaline power section for the Space Station Prototype (SSP) fuel cell subsystem. The first task was to establish a preliminary SSP power section design to be representative of the 200 cell Space Station power section. The second task was to conduct tooling and fabrication trials and fabrication of selected cell stack components. A lightweight, reliable cell stack design suitable for the SSP regenerative fuel cell power plant was completed. The design meets NASA's preliminary requirements for future multikilowatt Space Station missions. Cell stack component fabrication and tooling trials demonstrated cell components of the SSP stack design of the 1.0 sq ft area can be manufactured using techniques and methods previously evaluated and developed.

N87-28825\*# Microsemi Corp., Torrance, Calif. Power Technology Components.

SPACE STATION POWER SEMICONDUCTOR PACKAGE
VILNIS BALODIS, ALBERT BERMAN, DARRELL DEVANCE,

GERRY LUDLOW, and LEE WAGNER Sep. 1987 115 p (Contract NAS3-24662)

(NASA-CR-180829; NAS 1.26:180829) Avail: NTIS HC A06/MF A01 CSCL 09A

A package of high-power switching semiconductors for the space station have been designed and fabricated. The package includes a high-voltage (600 volts) high current (50 amps) NPN Fast Switching Power Transistor and a high-voltage (1200 volts), high-current (50 amps) Fast Recovery Diode. The package features an isolated collector for the transistors and an isolated anode for the diode. Beryllia is used as the isolation material resulting in a thermal resistance for both devices of .2 degrees per watt. Additional features include a hermetical seal for long life -- greater than 10 years in a space environment. Also, the package design resulted in a low electrical energy loss with the reduction of eddy

currents, stray inductances, circuit inductance, and capacitance. The required package design and device parameters have been achieved. Test results for the transistor and diode utilizing the space station package is given.

Author

N87-28959# European Space Agency, Paris (France).
PROCEEDINGS OF THE FIFTH EUROPEAN SYMPOSIUM ON PHOTOVOLTAIC GENERATORS IN SPACE

W. R. BURKE, comp. Nov. 1986 486 p Symposium held in The Hague/Scheveningen, The Netherlands 30 Sep. - 2 Oct. 1986; sponsored by ESA, the Netherlands Agengy for Aerospace Programs, and the Royal Netherlands Aircraft Factories (ESA-SP-267; ISSN-0379-6566; ETN-87-90157) Avail: NTIS HC

A21/MF A01
Some areas of discussion at the symposium are solar cell

technology, module technology, solar arrays, environmental interaction, in-flight performance, and alternative power generation. Also, cell assembly technology, solar array analytical modeling, and tests and measurements were discussed.

**ESA** 

N87-28960# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THE SPACE STATION POWER SYSTEM

COSMO R. BARAONA *In* ESA Proceedings of the Fifth European Symposium on Photovoltaic Generators in Space p 3-11 Nov. 1986

Avail: NTIS HC A21/MF A01

The major requirements and guidelines that affect the NASA Space Station configuration and the power system are explained. The evolution of the Space Station power system from the NASA program development-feasibility phase through the preliminary design phase is described. Early station concepts, both fanciful and feasible, are described and linked to the present concept. The Phase B trade study selections of photovoltaic system technologies are detailed. Solar dynamic and power management and distribution systems are summarized.

N87-28961# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ALTERNATIVE POWER GENERATION CONCEPTS FOR SPACE

HENRY W. BRANDHORST, JR., ALBERT J. JUHASZ, and BARBARA I. JONES *In* ESA Proceedings of the Fifth European Symposium on Photovoltaic Generators in Space p 13-19 Nov. 1986

Avail: NTIS HC A21/MF A01

Trade and optimization studies that highlight the potential of solar and nuclear dynamic systems relative to photovoltaic power systems are summarized. The solar dynamic case is the LEO Stirling system, while the nuclear system is the SP-100 system goal. Nuclear systems have the potential for the lightest weight, least area, sunlight independent, radiation-durable system. Solar dynamic systems pose a stiff challenge to photovoltaic systems in the midaltitudes because of their insensitivity to the Van Allen radiation belts. While the initial operational capability space station power system is only slightly superior to the SOA PV system, with development focused on the key technologies, advanced solar dynamic systems are fully competitive in LEO midaltitudes with the advanced photovoltaic systems. Advances in energy storage systems (100 Whrs/kg required) are essential.

N87-28972# Centre National d'Etudes Spatiales, Toulouse (France).

THE HIGH PERFORMANCE SOLAR ARRAY GSR3

A. MAMODE, J. BARTEVIAN, J. L. BASTARD, P. AUFFRAY, and A. PLAGNE (Societe Nationale Industrielle Aerospatiale, Les Mureaux, France) *In* ESA Proceedings of the Fifth European Symposium on Photovoltaic Generators in Space p 95-103 Nov. 1986

Avail: NTIS HC A21/MF A01

A fold out solar array with carbon-frame panel structure and stirrup-fastening peripheral hold-down concept for communication

satellites in multiple payload launches was developed. Over 35W/kg end of life is achieved by using BSR 180 micron classic solar cells. Computation shows that the 50W/kg line can be surpassed with 50 micron BSFR solar cells. Modularity and versatility as well as expected performances suggest an extension to domains such as low-orbit missions, space stations, and retractable solar arrays.

N87-28973# Royal Netherlands Aircraft Factories Fokker, Schiphol-Oost. Space Div.

## EURECA APPLICATION OF THE RETRACTABLE ADVANCED RIGID ARRAY (RARA) SOLAR ARRAY

J. DEKAM In ESA Proceedings of the Fifth European Symposium on Photovoltaic Generators in Space p 105-114 Nov. 1986
Avail: NTIS HC A21/MF A01

A reusable, retractable solar array for low Earth orbit free flyers was designed. The design can be applied for power up to 10 kW, but can be extended. The rigid concept allows for a simple and therefore reliable and cost effective design. A high design flexibility with respect to wing lay out and interface is featured. It will be applied on EURECA in a 5 kW version.

N87-28975# Royal Netherlands Aircraft Factories Fokker, Amsterdam.

## THE INMARSAT SOLAR ARRAY: THE FIRST ADVANCED RIGID ARRAY (ARA) TO FLY

PH. J. ZIJDEMANS In ESA Proceedings of the Fifth European Symposium on Photovoltaic Generators in Space p 123-127 Nov. 1986

Avail: NTIS HC A21/MF A01

Design and verification of a project solar array from a generic concept are described. Part level and wing level testing prove that the rigid design option yields a viable and promising solar array family, capable of delivering 30 to 40 W/kg, 10 yr end of life, within the range of application of 1 to 4 kW.

## N87-28976# AEG-Telefunken, Wedel (West Germany). HIGH POWER SOLAR ARRAY TECHNOLOGIES

G. BEHRENS In ESA Proceedings of the Fifth European Symposium on Photovoltaic Generators in Space p 131-136 Nov. 1986

Avail: NTIS HC A21/MF A01

Potential high power solar arrays for the Columbus program were investigated with regard to critical technologies needed for their electrical parts. The investigations and assessments for definition of technology items where specific problems exist and further work is necessary are described. Main problem areas are the harness concept, manufacturing, and high voltage and environmental aspects.

N87-28977# Marconi Space Systems Ltd., Portsmouth (England).

#### GAAS CONCENTRATOR SOLAR ARRAYS

J. M. HARVEY, J. HOWARD, and D. HAYWOOD In ESA Proceedings of the Fifth European Symposium on Photovoltaic Generators in Space p 137-144 Nov. 1986

Avail: NTIS HC A21/MF A01

The planar trough concentrators (PTC) for the Olympus and Cassegrain concentrators for the Columbus solar arrays were compared. The study of the PTC shows that it is a feasible concept, retaining the major configuration of a planar array. The PTC gives a 10 percent mass saving, and 40 percent area reduction, over a GaAs planar as well as a 40 percent reduction in quantity of cells required. These savings of mass, area, and cell costs make the GaAs PTC a worthwhile contender for geostationary satellites. Although the Cassegrain concentrator appears disadvantageous against planar GaAs in terms of mass and area, the saving in cells of 75 percent and in bulk cell material of 98.5 percent gives the Cassegrain a large cost advantage. The large number of 2 x 2 cm GaAs cells required is considered beyond present supply capability for the planar solution. Therefore the Cassegrain concentrator is advantageous for large LEO spacecraft.

N87-28979# Royal Netherlands Aircraft Factories Fokker, Amsterdam.

#### THE FOKKER STRONGBACK SOLAR ARRAY

R. ZWANENBURG In ESA Proceedings of the Fifth European Symposium on Photovoltaic Generators in Space p 151-157 Nov. 1986

Avail: NTIS HC A21/MF A01

The Strongback solar array with rigid solar panels offers a design solution for power levels up to 40 kW. The strongback array deploys the panels simultaneously in a synchronized way. The deployment is actuated by deployment springs. Deployment control and retraction is possible. High strength and stiffness in deployed condition is obtained by the preloaded truss-type structure. A life size model of 9 m length demonstrates the performances.

N87-28980# Centre d'Etudes et de Recherches, Toulouse (France). Dept. Technologie Spatiale.

## MARECS AND ECS ANOMALIES: ATTEMPT AT INSULATION DEFECT PRODUCTION IN KAPTON

L. LEVY, R. REULET, D. SARRAIL, J. M. SIGUIER, and H. LECHTE (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) In ESA Proceedings of the Fifth European Symposium on Photovoltaic Generators in Space p 161-169 Nov. 1986

Avail: NTIS HC A21/MF A01

Experiments were conducted on solar array samples to reproduce the short circuits assumed to be responsible for the ECS and MARECS in-orbit power losses. Discharges were produced between the interconnects and the cover-slides according to the inverted gradient voltage concept in presence of the solar array voltage. The theory that such low voltages could maintain an arc, leading to a permanent short circuit, burning away the Kapton, provided the discharge be triggered by a higher voltage was assessed. It was not possible to produce any permanent insulation defect through the insulation Kapton layer. The discharges by themselves are clearly not sufficient to produce the failure.

N87-28981# Fraunhofer-Inst. fuer Kurzzeitdynamik, Weil am Rhein (West Germany).

#### MICROMETEORITE IMPACT ON SOLAR PANELS

E. SCHNEIDER In ESA Proceedings on the Fifth European Symposium on Photovoltaic Generators in Space p 171-174 Nov. 1986

Avail: NTIS HC A21/MF A01

A micrometeorite simulation program studied damage phenomena and failure mechanisms of solar panels under hypervelocity impact conditions, to see if space debris and micrometeorites cause short circuits in solar arrays, e.g., of MARECS-A satellite. Experiments demonstrate that transient and permanent short circuits can be produced by particle impact. Arc discharges can be initiated under realistic electrical power conditions. There is evidence that failures caused by impact induced short circuits can be minimized by improving the geometrical arrangement of the panels and by optimizing the electrical circuitry.

N87-28982# Technische Univ., Munich (West Germany). Lehrstuhl fuer Raumfahrttechnik.

#### MICROMETEORITE EXPOSURE OF SOLAR ARRAYS

U. WEISHAUPT, H. KUCZERA, and M. ROTT In ESA Proceedings of the Fifth European Symposium on Photovoltaic Generators in Space p 175-180 Nov. 1986 (Contract ESA-6238/85-NL-AN)

Avail: NTIS HC A21/MF A01

Permanent losses of a part of the available power on solar arrays of ESA satellites, possibly caused by micrometeoroid or space debris impacts were studied in hypervelocity impact simulations at a plasma accelerator using ECS and Olympus solar panel structures. Results confirm that significant damage of the solar arrays can be caused by small hypervelocity particles. Using a solar array simulator connected to the test sample, penetration

phenomena and arc triggering effects were investigated within the efficiency range of the accelerator. Temporary or permanent short circuits between the solar cells and the panel structure may lead to a loss of solar array power and additional damage may be created if arcing occurs.

N87-28984# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

STOPPING DIFFERENTIAL CHARGING OF SOLAR ARRAYS
H. G. LECHTE In its Proceedings of the Fifth European Symposium
on Photovoltaic Generators in Space p 189-193 Nov. 1986
Avail: NTIS HC A21/MF A01

Assuming that the build up of electrostatic charge on solar arrays of geostationary satellites is a contributing factor in reducing the lifetime of insulators, the mechanism of charging the elements of a rigid solar array was analyzed and means to reduce differential charging proposed. These include avoidance of charging the array rear, a better matching of secondary emission yields between both faces of the array, and the provision of an electrical leakage path between cover slips and solar cells to bleed off any charge. It is advised that the design of solar generators for geostationary missions takes seriously into account the build up of electrostatics and provides for sufficient precautions against resulting stresses, including those from micrometeorites.

# N87-28985# Centro Informazioni Studi Esperienze, Milan (Italy). ADVANCED SOLAR GAAS ARRAY (ASGA) EXPERIMENT ON EURECA: FLIGHT OBJECTIVES AND INSTRUMENT CONFIGURATION

L. BERTOTTI, C. FLORES, F. PALETTA, and L. ZULIANI (Consiglio Nazionale delle Ricerche, Rome, Italy ) /n ESA Proceedings of the Fifth European Symposium on Photovoltaic Generators in Space p 197-202 Nov. 1986 Sponsored by CNR Avail: NTIS HC A21/MF A01

The Advanced Solar GaAs Array (ASGA) experiment consists of a solar panel with different GaAs solar cells to be flown by EURECA-1. During the whole mission electrical and thermal data relevant to different strings of cells are automatically recorded by dedicated electronics to check the performance trend of GaAs solar cells when exposed to the low Earth orbit environment. The EURECA flight gives an opportunity to evaluate the properties of standard and advanced GaAs solar cells over a period of 6 months. The EURECA environment (the same as that for the future space station) is characterized by: high number of eclipses, low radiation density, and atomic oxygen erosion. The ASGA experiment tests the effects of these physical aspects on different kind of cells. On the solar panel, concentrator and planar cells will be mounted.

N87-28986# Societe Nationale Industrielle Aerospatiale, Cannes (France).

## SPOT SOLAR ARRAY IN-ORBIT DEPLOYMENT RESULTS EVALUATION

PH. BOBO In ESA Proceedings of the Fifth European Symposium on Photovoltaic Generators in Space p 203-206 Nov. 1986 Avail: NTIS HC A21/MF A01

The design and deployment sequence of the SPOT satellite flexible solar array are recalled. The analysis tools whereby in-orbit behavior can be retrieved are described. Results from telemetry deliveries are presented and evaluated to derive solar generator flight data. Performances are compared to predictions or simulations. The performance budget shows good performance-prediction correlation, increasing confidence level for this solar array subsystem, three specimens of which are in production.

## N87-29004# Telespazio, S.p.A., Rome (Italy). THERMAL-ELECTRICAL DYNAMICAL SIMULATION OF SPACECRAFT SOLAR ARRAY

M. RETICCIOLI In ESA Proceedings of the Fifth European Symposium on Photovoltaic Generators in Space p 317-326 Nov. 1986

Avail: NTIS HC A21/MF A01

An approach to model, in an electrical analogy, a spacecraft solar array in the space environment during operating life is outlined. Thermal and electrical coupling effects are dynamically taken into account, so that the thermal and electrical behavior during spacecraft transient events can be simulated. The model takes into account other factors affecting the output power, such as illumination, environmental conditions, and seasonal and aging factors. Since the model is defined in terms of equivalent electrical circuits a general purpose circuit simulation program, such as SPICE, can be utilized. Results of simulations are reported. ESA

## N87-29006# Indian Space Research Organization, Bangalore. DESIGN AND FABRICATION OF STRETCHED ROHINI SATELLITE-1 SOLAR ARRAY

N. SRINIVASAMURTHY, M. SUDHAKAR, B. L. AGRAWAL, and A. U. GOPALAN (Indian Space Research Organization, Trivandrum.) In ESA Proceedings of the Fifth European Symposium on Photovoltaic Generators in Space p 333-342 Nov. 1986

Avail: NTIS HC A21/MF A01

The SROSS satellites solar array studies and selected configuration are described. Mission demands are such that spinning and three axis stabilized satellites are required. A single bus satellite design catering to both types of mission requirements was envolved, imposing severe constraints on the solar array design. The satellite structure is an octagonal cylinder. The eight deployed panels are stowed against the corresponding body mounted fixed panels. The deployed panels contain cell on both sides and each deployed panel makes an angle of 135 deg with the corresponding body mounted panel when deployed. A modification in this configuration is to distribute the deployable panels on each end of the octagon. The SROSS satellites require 96 W raw power for 3 axis stabilized versions, 66 W for spinners.

N87-29010# Lockheed Missiles and Space Co., Sunnyvale, Calif.

## TEST RESULTS FROM THE SOLAR ARRAY FLIGHT EXPERIMENT

GARY F. TURNER and MIKE D. MENNING In ESA Proceedings of the Fifth European Symposium on Photovoltaic Generators in Space p 365-372 Nov. 1986
Avail: NTIS HC A21/MF A01

The Solar Array Flight Experiment flown on STS-41D demonstrated the readiness of this technology and associated analytical tools to support advanced programs such as Space Station. The solar array, which measured 4.5 x 31.5 m, was successfully deployed and retracted several times during the mission, and electrical, mechanical, and dynamic performance was observed and measured, with excellent correlation with preflight predictions.

## N87-29882\*# AEC-Able Engineering Co., Inc., Goleta, Calif. SPACE STATION ALPHA JOINT BEARING

MICHAEL R. EVERMAN, P. ALAN JONES, and PORTER A. SPENCER (Lockheed Missiles and Space Co., Sunnyvale, Calif.) In NASA-Lyndon B. Johnson Space Center, The 21st Aerospace Mechanisms Symposium p 329-343 May 1987 Avail: NTIS HC A16/MF A01 CSCL 131

Perhaps the most critical structural system aboard the Space Station is the Solar Alpha Rotary Joint which helps align the power generation system with the sun. The joint must provide structural support and controlled rotation to the outboard transverse booms as well as power and data transfer across the joint. The Solar Alpha Rotary Joint is composed of two transition sections and an integral, large diameter bearing. Alpha joint bearing design presents a particularly interesting problem because of its large size and need for high reliability, stiffness, and on orbit maintability. The discrete roller bearing developed is a novel refinement to cam follower technology. It offers thermal compensation and ease of on-orbit maintenance that are not found in conventional rolling

element bearings. How the bearing design evolved is summarized. Driving requirements are reviewed, alternative concepts assessed, and the selected design is described.

N87-29915\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

STATUS OF SPACE STATION POWER SYSTEM

COSMO R. BARAONA and DEAN W. SHEIBLEY In its Space Electrochemical Research and Technology (SERT) p 1-8 Sep. 1987

Avail: NTIS HC A16/MF A01 CSCL 22B

The major requirements and guidelines that affect the manned space station configuration and the power systems are explained. The evolution of the space station power system from the NASA program development feasibility phase through the current preliminary design phase is described. Several early station concepts are described and linked to the present concept. The recently completed phase B tradeoff study selections of photovoltaic system technologies are described. The present solar dynamic and power management and distribution systems are also summarized for completeness.

N87-29917\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

JPL FUTURE MISSIONS AND ENERGY STORAGE TECHNOLOGY IMPLICATIONS Abstract Only

EUGENE V. PAWLIK In NASA-Lewis Research Center, Space Electrochemical Research and Technology (SERT) p 15 Sep. 1987

Avail: NTIS HC A16/MF A01 CSCL 10C

The mission model for JPL future programs is presented. This model identifies mission areas where JPL is expected to have a major role and/or participate in a significant manner. These missions are focused on space science and applications missions, but they also include some participation in space station activities. The mission model is described in detail followed by a discussion on the needs for energy storage technology required to support these future activities.

N87-29938\*# Texas A&M Univ., College Station. Dept. of Chemical Engineering.

REGENERATIVE FUEL CELLS FOR SPACE APPLICATIONS

A. JOHN APPLEBY In NASA-Lewis Research Center, Space Electrochemical Research and Technology (SERT) p 213-220 Sep.

Avail: NTIS HC A16/MF A01 CSCL 10C

After several years of development of the regenerative fuel cell (RFC) as the electrochemical storage system to be carried by the future space station, the official stance has now been adopted that nickel hydrogen batteries would be a better system choice. RFCs are compared with nickel hydrogen and other battery systems for space platform applications.

#### 08

#### **ELECTRONICS**

Includes descriptions of analytical techniques, analyses, systems, and requirements for internal and external communications, electronics, sensors for position and systems monitoring and antennas.

A87-31461\*# National Aeronautics and Space Administration.
Lyndon B. Johnson Space Center, Houston, Tex.

SPACE STATION INTEGRATION AND VERIFICATION CONCEPTS

EDWARD S. CHEVERS (NASA, Johnson Space Center, Houston, TX) IN: Digital Avionics Systems Conference, 7th, Fort Worth, TX, Oct. 13-16, 1986, Proceedings . New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 93-99.

The TAVERNS concept for the integration, verification, and maintenance of the Space Station avionics and payload systems is described. The functional requirements which TAVERNS integrates are discussed, showing the mode of integration and the flight systems integration. The top and bottom TAVERNS sections are described, and the use of TAVERNS to develop software required for flight applications and testing is discussed.

A87-31462\* RCA Communications Systems Div., Camden, N. J. MULTIPLE ACCESS KU-BAND COMMUNICATIONS

SUBSYSTEM FOR THE SPACE STATION

G. E. MACKIW (RCA, Communication and Information Systems Div., Camden, NJ) IN: Digital Avionics Systems Conference, 7th, Fort Worth, TX, Oct. 13-16, 1986, Proceedings . New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 100-104. (Contract NAS9-17471)

This paper presents the results of advanced work on system design for the Space Station Multiple Access Subsystem (SSMAS), which includes equipment aboard the Space Station itself and aboard the space-borne group of user vehicles. In addition to the system development efforts, early hardware design work is being performed. A Ku-band transceiver representing the EVA or other equipment configuration has been breadboarded and system testing performed. Additional hardware is being designed for NASA JSC, which will be assembled to form a SSMAS test bed where the subsystem itself, as well as its hardware components, will be tested and evaluated.

A87-32235\*# Old Dominion Univ., Norfolk, Va.
ROBUST CONTROLLER SYNTHESIS FOR A LARGE FLEXIBLE
SPACE ANTENNA

N. SUNDARARAJAN (Old Dominion University Research Foundation, Norfolk, VA), S. M. JOSHI, and E. S. ARMSTRONG (NASA, Langley Research Center, Hampton, VA) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 10, Mar.-Apr. 1987, p. 201-208. refs

The linear-quadratic Gaussian/loop-transfer-recovery method is used to synthesize a fine-pointing control system for a large space antenna. A finite-element model for the 122-m hoop/column antenna is employed, and a compensator, utilizing attitudes sensors and torque actuators, is designed which achieves pointing performance while maintaining stability robustness to unmodeled dynamics. Inclusion of the rigid-body modes plus the first three elastic modes is found to be necessary to achieve a 0.1-rad/s bandwidth. Results are obtained by employing a modification of the standard robustness recovery procedure, which reduces the conservative nature of the design methodology. Performance degradation is encountered due to the presence of unavoidable invariant zeros within the design bandwidth.

## A87-34797 COMMUNICATION MISSIONS FOR GEOSTATIONARY

TAKASHI IIDA, MASAAKI SHIMADA, SHIGETOSHI YOSHIMOTO YOSHIAKI SUZUKI, and KAZUHIKO HASHIMOTO (Ministry o Posts and Telecommunications, Radio Research Laboratory Koganei, Japan) Space Communication and Broadcasting (ISSN 0167-9368), vol. 4, Dec. 1986, p. 425-433. refs

It is estimated that several thousand transponders will be needed in the 36 MHz slot by the year 2000 by the U.S. and Japan, while the GEO position above the U.S. will be congested and the slot above Japan is shared by the Soviets. Additional demands may arise from the development of mobilicommunications services in Japan and the U.S. A large GEC platform could benefit from the economies of scale by making servicing an economical prospect. The platform could carry 50/46 GHz antennas for personal radio communications, multibeam DBS antennas, a mobile telephone system functioning at 900/800 MHz a relay station for earth-moon communications, and global data relay system. The limitations and necessary operational parameter of each system are examined.

#### A87-40380

#### ON-BOARD COMMUNICATIONS, INCLUDING EVA

THOMAS L. LINDLEY (Rockwell International Corp., Space Station Systems Div., Downey, CA) IN: EASCON '86; Proceedings of the Nineteenth Annual Electronics and Aerospace Systems Conference, Washington, DC, Sept. 8-10, 1986 . New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 266-269.

The Space Station will serve as a central node in a major communications network. It will service a large variety of users located at numerous ground sites and in a number of coorbiting and polar orbiting free flying satellites, platforms, and associated support spacecraft, such as the Shuttle Orbiter, Orbiter Maneuvering Vehicles, and future Orbiter Transfer Vehicles. Space to ground communications will be through the Tracking and Data Relay Satellite System or through equivalent systems. In addition to the external communications nodes, there will be a large number of complex on-board payloads and video cameras that will generate data that must pass through the Tracking and Data Relay Satellite System to associated ground based Payload/Operation Centers. A Space to Space Communications System provides a link between Space Station and EVA astronauts.

#### A87-41302#

### CARBON FIBRE SLOTTED WAVEGUIDE ARRAYS

R. WAGNER (Dornier System GmbH, Friedrichshafen, West Germany) IN: Military microwaves '86; Proceedings of the Conference, Brighton, England, June 24-26, 1986. Tunbridge Wells, England, Microwave Exhibitions and Publishers, Ltd., 1986, p. 231-236. Research sponsored by the Swedish Space Corp., DFVLR, BMFT, and ESA.

Spaceborne SARs call for antennas of large aperture and high structural performance; attention is accordingly given to the slotted waveguide antenna concept, which yields high aperture efficiency, good beam-shaping, and low losses in conjunction with great compactness and high stiffness. A distinctive technology for the manufacture of such waveguides from metallized carbon fiber-reinforced plastics, as well as for the construction of radiating arrays for such waveguides, is presented.

O.C.

## A87-41609\*# Systems Science and Software, La Jolla, Calif. THEORY OF PLASMA CONTACTORS FOR ELECTRODYNAMIC TETHERED SATELLITE SYSTEMS

D. E. PARKS and I. KATZ (Systems, Science and Software, La Jolla, CA) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 24, May-June 1987, p. 245-249. Previously announced in STAR as N86-28430. refs (Contract NAS3-23881)

Recent data from ground and space experiments indicate that plasma releases from an object dramatically reduce the sheath impedance between the object and the ambient plasma surrounding it. Available data is in qualitative accord with the theory developed to quantify the flow of current in the sheath. Electron transport in the theory is based on a fluid model of a collisionless plasma with an effective collision frequency comparable to frequencies of plasma oscillations. The theory leads to low effective impedances varying inversely with the square root of the injected plasma density. To support such a low impedance mode of operation using an argon plasma source, for example, requires that only one argon ion be injected for each thirty electrons extracted from the ambient plasma. The required plasma flow rates are quite low; to extract one ampere of electron current requires a mass flow rate of about one gram of argon per day. Author

## A87-45483\* LinCom Corp., Los Angeles, Calif. FDMA SYSTEM DESIGN AND ANALYSIS FOR SPACE STATION

CHIT-SANG TSANG, CHAK-MING CHIE (LinCom Corp., Los Angeles, CA), and JAMES E. RATLIFF (NASA, Johnson Space Center, Houston, TX) IN: GLOBECOM '86 - Global Telecommunications Conference, Houston, TX, Dec. 1-4, 1986, Conference Record. Volume 1 . New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 133-137. refs (Contract NAS9-17332)

Space Station FDMA communications system requirements, design, and analysis are addressed. The analysis is primarily based on numerical results generated by a computer simulation system called SCSS. The time-line communications performance during real time mission operation is also discussed. The purpose of this paper is three-fold: introduction to Space Station multiple access communications system requirements, demonstration of system analysis by a computer tool, and design of an FDMA communications system for the Space Station.

**A87-45519\*** Harris Government Aerospace Systems Div., Melbourne, Fla.

## MULTIPLE BEAM PHASED ARRAY FOR SPACE STATION CONTROL ZONE COMMUNICATIONS

P. B. HALSEMA (Harris Corp., Government Aerospace Systems Div., Melbourne, FL) IN: GLOBECOM '86 - Global Telecommunications Conference, Houston, TX, Dec. 1-4, 1986, Conference Record. Volume 2 . New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 818-821. (Contract NAS9-17472)

The Space Station Communications Control Zone is a disk shaped region 40 nautical miles in diameter and 10 nautical miles thick centered about the Space Station. It is estimated that 6 simultaneous Multiple Access (MA) channels will be required to satisfy the projected communications needs within this zone. These channels will be used to communicate with MA users located anywhere within the Control Zone. This paper details the tradeoffs and design implementation of a multiple beam integrated phased array to provide antenna coverage of the Control Zone. The array is a compact, modular assembly using Gallium Arsenide circuits, microstrip elements, and advanced packaging techniques. This results in a small, reliable antenna system capable of meeting the projected Space Station requirements and flexible enough to grow and evolve as the Space Station communications needs develop.

#### Autho

#### A87-45520

## SPACE STATION TRACKING SUBSYSTEM SENSOR EVALUATION

JAMES T. YONEMOTO and GREGG E. BURGESS (Hughes Aircraft Co., Space and Communications Group, El Segundo, CA) IN: GLOBECOM '86 - Global Telecommunications Conference, Houston, TX, Dec. 1-4, 1986, Conference Record. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 822-825.

Candidate U.S. Space Station tracking subsystem sensors were identified and evaluated on the preliminary design phase of the Space Station program. The sensors investigated included radars, laser-based sensors, Global Positioning System receivers, passive electro-optical sensors, and video tracking systems. Both individual snsors and complements of sensors were evaluated for their ability to support assumed vehicular operations in the vicinity of the Station. Two of these sensors, the passive electro-optical and video tracking sensors, are described. Analyses and dynamic performance simulations indicate that each can meet the postulated performance requirements.

#### A87-45522

#### END-TO-END COMMUNICATIONS FOR SPACE STATION

S. BRUCE FRANKLIN, CHARAN J. LANGTON, ROBERT E. VAUGHAN, and ROBERT M. WARD, JR. (TRW, Inc., TRW Electronic Systems Group, Redondo Beach, CA) IN: GLOBECOM '86 - Global Telecommunications Conference, Houston, TX, Dec. 1-4, 1986, Conference Record. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 832-837.

The top level problem of transporting a complex mix of data between the multitude of terminals and users that comprise the Space Station community is addressed in this paper. The end-to-end communications architecture is partitioned into relatively independent segments related to space-to-ground communications via the Tracking and Data Relay Satellite System (TDRSS), space-to-space communications via a new multiple-access communications system, and ground-to-ground communications via

existing and needed capabilities. Partitions are also defined within the three major nodes - onboard the Space Station; onboard polar and coordinating platforms or free flyers; and within major NASA centers. Emphasis is on data communications within and between the major nodes; data transfer concepts, capabilities, and limitations.

**A87-45524\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

### SPACE STATION MULTIPLE ACCESS COMMUNICATIONS

NANCI A. OLSON (NASA, Johnson Space Center, Houston, TX) IN: GLOBECOM '86 - Global Telecommunications Conference, Houston, TX, Dec. 1-4, 1986, Conference Record. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 843-846.

The development of a multiple access communications system (MACS) for the space-to-space communications on the Space Station is discussed. The communications capabilities of the FHMA, CDMA, TDMA, SDMA, and FDMA techniques are evaluated; FDMA was selected for the space-to-space communications on the Space Station because of its lower complexity and growth capability. The proposed space-to-space multiple access system for the Space Station is a digitally modulated Ku-band FDMA system with a distributed architecture; this system would transmit on frequencies between 13.4 and 13.7 GHz and receive on frequencies between 14.6 and 14.89 GHz, and the bandwidth will support seven high-data-rate users and 12 low-data-rate users. The IF components and antennas for the MACS are examined. A multiple access breadboard design is described.

#### A87-46281 ON-BOARD K- AND S-BAND MULTI-BEAM ANTENNAS

TAKAO ITANAMI, MASAHIRO MINOMO, and KENJI UENO (Nippon Telegraph and Telephone Public Corp., Radio Communications Networks Laboratories, Musashino, Electrical Communications Laboratories, Review (ISSN 0029-067X), vol. 35, March 1987, p. 159-167. refs

This paper describes the configurations and performances of foldable 1.3 m K- and 3.5 m S-band offset Cassegrain multibeam antenna module on a three axes stabilized bus. This module is accommodated to a limited launch vehicle payload area of 2.2 m in inner diameter and 2.8 m in height. Electrical and structural tests results confirm that manufactured antenna characteristics agree well with the design values and that these antennas are well suited to on-board equipment.

## A87-50157# DESIGN OF A BEACON RECEIVING SYSTEM FOR THE OLYMPUS SATELLITE

ERKKI SALONEN (Helsinki University of Technology, Espoo, Finland) IN: International Beacon Satellite Symposium on Radio Beacon Contribution to the Study of Ionization and Dynamics of the Ionosphere and to Corrections to Geodesy and Technical Workshop, Oulu, Finland, June 9-14, 1986, Proceedings. Part 2. Oulu, Finland, University of Oulu, 1986, p. 359-365.

The main features of the design of the propagation measurement system for the 12.5, 20, and 30 GHz Olympus 1 satellite beacons are described. Progress being made at the Metsaehovi Radio Research Station in Finland is discussed. The main goals of the propagation measurement are to collect statistics of attenuation, scintillation, and crosspolarization events. The propagation payload of Olympus 1 is discussed as well as the choice of the frequency for the main phase-locked loop, the antenna and feed system, and data acquisition.

#### A87-50417#

#### ROBUST CONTROL OF A LARGE SPACE ANTENNA

MICHAEL F. BARRET and DANIEL J. BUGAJSKI (Honeywell Systems and Research Center, Minneapolis, MN) IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 1. New York, American

Institute of Aeronautics and Astronautics, 1987, p. 124-132. refs (AIAA PAPER 87-2253)

A methodology is developed for designing feedback control laws to accomplish large-angle (45 deg) slew maneuvers for a large space antenna and rapidly settle to within microrad pointing accuracy. It is shown that control torque requirements for settling critical antenna responses exceed current state-of-the-art (SOA) hardware capability by 2-3 orders of magnitude. An improved reaction control system was developed which substantially reduces the excitation of critical flexible modes. It is concluded that the performance criteria can be met using SOA control hardware, while robustness to unstructured uncertainty can be realized at either the input or output of the feedback loop.

N87-20339\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

# EFFECTS OF SPACE PLASMA DISCHARGE ON THE PERFORMANCE OF LARGE ANTENNA STRUCTURES IN LOW EARTH ORBIT

HANS-JUERGEN C. BLUME Feb. 1987 21 p (NASA-TM-89118; NAS 1.15:89118) Avail: NTIS HC A02/MF A01 CSCL 20I

The anomalous plasma around spacecrafts in low Earth orbit represents the coma of an artificial comet. The plasma discharge is caused by an energetic disturbance of charged particles which were formerly in a state of equilibrium. The plasma can effect the passive and active radio frequency operation of large space antennas by inducing corona discharge or strong arcing in the antenna feeds. One such large space antenna is the 15-meter hoop column antenna which consists of a mesh membrane material (tricot knitted gold plated wire) reflector and carbon fiber tension cords. The atomic oxygen in the plasma discharge state can force the wire base metal particles through the gold lattice and oxydize the metal particles to build a Schottky-barrier contact at the point where the wires meet. This effect can cause strong deviations in the reflector performance in terms of antenna pattern and losses. Also, the carbon-fiber cords can experience a strength reduction of 30 percent over a 40-hour exposure time.

N87-20360# Societe Nationale Industrielle Aerospatiale, Cannes (France).

## DYNAMIC ANALYSIS OF DIRECT TELEVISION SATELLITE TV-SAT/TDF.1

Y. PLUMAT In AGARD Mechanical Qualification of Large Flexible Spacecraft Structures 8 p Jul. 1986
Avail: NTIS HC A12/MF A01

An application of the methods of analysis for the structural behavior of spacecraft whose bottom is affected by a vibrational environment is discussed. The application concerns the Direct Broadcast satellites TV-SAT and TDF.1, for which sine vibration qualification and acceptance are achieved through combination of the theoritical analysis (finite element method and frequential response) and of the experimental (sine vibrations test) verification of some subsystems and system assembles. This procedure requires highly detailed mathematical models, which are validated by way of in depth correlation between the test predictions and test dynamic results. TV-SAT and TDF.1 satellites are a specially worthwhile illustration for the said type of studies as they are a pair of large, wholly European built spacecrafts whose structures are made up of several major subassemblies, namely: main body, propellant tanks, Antenna module complete with reflectors, solar Author

# N87-22876# Naval Postgraduate School, Monterey, Calif. THE EFFECT OF MULTIPATH ON DIGITAL COMMUNICATIONS SYSTEMS: WITH APPLICATION TO SPACE STATION M.S. Thesis

WILLIAM J. TOTI Dec. 1986 98 p

(AD-A178578) Avail: NTIS HC A05/MF A01 CSCL 17B

Analysis of the effect of multipath propagation on digital communications systems was conducted. A brief overview of the root causes of multipath propagation was included in this discussion. Probabilities of error were then derived for a generalized

digital communications system experiencing Rician fading due to multipath propagation. Exact results were obtained for equiprobable M-ary Frequency Shift Keyed and M-ary Phase Shift Keyed modulation schemes used to transmit digital data. Furthermore, the probability of error was obtained for a generalized digital communication system experiencing single-bit Intersymbol Interference due to multipath propagation. Finally, the performance of digital communication links for NASA's space station operating in the presence of Intersymbol Interference was evaluated. Results obtained tend to show that severe communication system performance degradation may occur on those links under certain transmitter/receiver and space station geometries.

Honeywell Systems and Research Center, N87-24499\*# Minneapolis, Minn.

#### ROBUST CONTROL FOR LARGE SPACE ANTENNAS

M. F. BARRETT In NASA-Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 p 637-664 Jun.

Avail: NTIS HC A14/MF A01 CSCL 13I

A brief description of program objectives and the space based radar application is given. General characteristics of the 100 m diameter reflector spacecraft are described along with the intended mission and associated requirements, and dynamic characteristics relevant to that mission. Preliminary control analyses are carried out for the critical rapid slew and settle maneuver to establish feedback control requirements and fundamental limitations in meeting those requirements with control hardware for a baseline reaction control system (RCS) jet placement assumed for the open loop bang-bang slew limitations. Control moment gyros (CMGs), angular position sensors, and linear translation sensors are placed for feedback control. Control laws are designed for the improved sensor and actuator placement and evaluated for performance and robustness to unstructured model uncertainty. The robustness of the control design is assessed with respect to modal parameter uncertainty. Results of the control designs analyses are summarized, conclusions are drawn, and recommendations made for future studies.

#### N87-24503\*# Martin Marietta Aerospace, Denver, Colo. **BOX TRUSS ANTENNA TECHNOLOGY STATUS**

J. V. COYNER and E. E. BACHTELL In NASA-Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 p 717-736 Jun. 1987 Previously announced as 87N-16023

Avail: NTIS HC A14/MF A01 CSCL 22B

Recent technology development activities for box truss structures and box truss antennas are summarized. Three primary activities are discussed: the development of an integrated analysis system for box truss mesh antennae; dynamic testing to characterize the effect of joint free play on the dynamic behavior of box truss structures; and fabrication of a 4.5 meter diameter offset fed mesh reflector integrated to an all graphite epoxy box truss cube.

N87-24504\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

### HOOP/COLUMN AND TETRAHEDRAL TRUSS

**ELECTROMAGNETIC TESTS** 

M. C. BAILEY In its NASA/DOD Control/Structures Interaction Technology, 1986 p 737-746 Jun. 1987 Avail: NTIS HC A14/MF A01 CSCL 22B

The distortion of antennas was measured with a metric camera system at discrete target locations on the surface. Given are surface distortion for hoop column reflector antennas, for tetrahedral truss reflector antennas, and distortion contours for the tetrahedral truss reflector. Radiation patterns at 2.27-GHz, 4.26-GHz, 7.73-GHz and 11.6-GHz are given for the hoop column antenna. Also given are radiation patterns at 4.26-GHz and 7.73-GHz for the tetrahedral truss antenna.

N87-24508\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

#### ANTENNA TECHNOLOGY SHUTTLE EXPERIMENT (ATSE)

R. E. FREELAND, E. METTLER, L. J. MILLER, Y. RAHMET-SAMII. and W. J. WEBER, III In NASA-Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 p 779-807 Jun. 1987

Avail: NTIS HC A14/MF A01 CSCL 20N

Numerous space applications of the future will require mesh deployable antennas of 15 m in diameter or greater for frequencies up to 20 GHz. These applications include mobile communications satellites, orbiting very long baseline interferometry (VLBI) astrophysics missions, and Earth remote sensing missions. A Lockheed wrap rip antennas was used as the test article. The experiments covered a broad range of structural, control, and RF discipline objectives, which is fulfilled in total, would greatly reduce the risk of employing these antenna systems in future space applications. It was concluded that a flight experiment of a relatively large mesh deployable reflector is achievable with no major technological or cost drivers. The test articles and the instrumentation are all within the state of the art and in most cases rely on proven flight hardware. Every effort was made to design the experiments for low cost.

N87-26959# Atomic Energy Research Establishment, Harwell (England).

#### SURFACE MODIFICATION TO MINIMISE THE **ELECTROSTATIC CHARGING OF KAPTON IN THE SPACE ENVIRONMENT**

D. VERDIN and M. J. DUCK In AGARD, The Aerospace Environment at High Altitudes and its Implications for Spacecraft Charging and Communications 12 p May 1987 Sponsored in part by the Royal Aircraft Establishment, Farnborough, England Avail: NTIS HC A13/MF A01

The electrostatic charging of Kapton under electron irradiation is reduced by coating it with a dispersion of indium oxide in a soluble polyimide. The proportion of oxide in the coating and its thickness are chosen to give an optimum balance between the surface resistivity and the thermo-optical properties of the film.

#### N87-26960# Air Force Geophysics Lab., Hanscom AFB, Mass. **AUTOMATIC CHARGE CONTROL SYSTEM FOR GEOSYNCHRONOUS SATELLITES**

B. M. SHUMAN, H. A. COHEN, J. HYMAN, R. R. ROBSON, J. SANTORU, and W. S. WILLIAMSON (Hughes Research Labs., Malibu, Calif.) In AGARD, The Aerospace Environment at High Altitudes and its Implications for Spacecraft Charging and Communications 17 p May 1987 Avail: NTIS HC A13/MF A01

An autonomous system to detect both absolute and differential spacecraft charging aboard high altitude satellites and to reduce those potentials before hazardous arcing levels are reached is being developed. The principle of safely reducing spacecraft charging levels by the emission of a low energy neutral plasma, effectively shorting the spacecraft and charged dielectric surfaces to the ambient space plasma, was demonstrated. The Charge Control System will utilize a xenon-based plasma source capable of igniting within one second, and capable of emmiting a quasi-neutral plasma containing more than 1 mA of ions.

N87-26961# Aerospace Corp., Los Angeles, Calif. Sciences Lab.

#### THICK DIELECTRIC CHARGING ON HIGH ALTITUDE SPACECRAFT

A. L. VAMPOLA In AGARD, The Aerospace Environment at High Altitudes and its Implications for Spacecraft Charging and Communications 7 p May 1987 Previously announced as N87-13480

(Contract F04701-82-C-83)

Avail: NTIS HC A13/MF A01

Thick dielectric charging, in which energetic electrons embed within bulk dielectrics and build up to potentials in excess of the breakdown potential of the dielectric, is shown to be a causitive factor in the anomalous operation of high altitude satellites. Results of laboratory studies are reviewed and a table of maximum expected electron fluxes orbits of various altitudes is presented. The combination of maximum expected electron fluxes and the small energy associated with a bulk dielectric breakdown permits the elimination of bulk charging as a spacecraft problem through the minimum shielding (400 mg/sq cm) of all cables and circuit boards otherwise exposed to the environment, and through the desensitizing of digital logic inputs that are serviced by cables.

National Aeronautics and Space Administration. N87-29161\*# Langley Research Center, Hampton, Va.

**ELECTRONIC CONTROL/DISPLAY INTERFACE TECHNOLOGY** R. V. PARRISH, A. M. BUSQUETS, R. F. MURRAY, and J. J. HATFIELD In NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, Volume 2 25 p

Avail: NTIS HC A17/MF A01 CSCL 09B

An effort to produce a representative workstation for the Space Station Data Management Test Bed that provides man/machine interface design options for consolidating, automating, and integrating the space station work station, and hardware/software technology demonstrations of space station applications is discussed. The workstation will emphasize the technologies of advanced graphics engines, advanced display/control medias, image management techniques, multifunction controls, and video disk utilizations.

#### 09

#### PROPULSION/FLUID MANAGEMENT

Includes descriptions, analyses, and subsystem requirements for propellant/fluid management and propulsion systems for attitude control and orbit maintenance and transfer for the station and supporting elements such as the OMV and OTV.

#### A87-32645

REFUELING SATELLITES IN SPACE - THE OSCRS PROGRAM BARNEY F. GORIN (Fairchild Space Co., Germantown, MD) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 13-16, 1986. 17 p. (SAE PAPER 861797)

The configuration, use and overall space operations scenario envisioned for the Orbital Consumables Resupply System (OCRS) are summarized. The OCRS is to allow replenishment of consumables, product harvesting and removal of wastes from satellites from an orbital base on the Orbiter. Servicing will be carried out either directly from the Orbiter after grappling with the orbiter RMS or by a teleoperated orbital maneuvering vehicle. Systems to be serviced with the OCRS include the Space Station, Gamma Ray Observatory, free-flyers and GEO-stationed satellites. Both hypergolic and hydrazine monopropellants are to be carried in OCRS tanks in a polar mounting configuration in the Orbiter bay. Fuel transfer and pumping hardware and procedures, OCRS design features and Shuttle interface systems are outlined.

M.S.K.

National Aeronautics and Space Administration. A87-34712\* Ames Research Center, Moffett Field, Calif.

TRANSFERRING SUPERFLUID HELIUM IN SPACE

PETER KITTEL (NASA, Ames Research Center, Moffett Field, IN: Advances in cryogenic engineering. Volume 31. New York, Plenum Publishing Corp., 1986, p. 897-904. NASA-supported research.

A simple thermodynamic model of a transfer system for resupplying liquid helium in space is presented, with application to NASA projects including the Space Infrared Telescope Facility, the Large Deployable Reflector, and the Hubble Space Telescope. The relations between different thermodynamic regimes that can be expected in the transfer line are used to study the relative efficiencies of various possible transfer techniques. Low heat leak into the transfer line, particularly at point sources such as the coupling, is necesssary for efficient transfer of liquid helium, and proper selection of supply tank temperature is important during helium resupply.

#### A87-36756

DEMANDS IMPOSED ON A SURFACE TENSION PROPELLANT TANK DUE TO REFUELLABILITY IN THE MICROGRAVITY ENVIRONMENT OF OUTER SPACE [ANFORDERUNGEN AN OBERFLAECHENSPANNUNGSTANKS DURCH DIE WIEDERBETANKBARKEIT IM WELTRAUM UNTER SCHWERELOSIGKEIT]

G. NETTER and U. RENNER (MBB-ERNO Raumfahrttechnik GmbH, Bremen, West Germany) IN: Yearbook 1986 I; DGLR, Annual Meeting, Munich, West Germany, Oct. 8-10, 1986, Reports . Bonn, Deutsche Gesellschaft fuer Luft- und Raumfahrt, 1986, p. 35-44. In German. refs (DGLR PAPER 86-104)

The present status of refuelling in orbit is summarized, and problems of refuelling a surface-tension propellant tank in orbit are discussed. The physics of refilling the tank is briefly presented, and the ways that various types of tanks approach problems related to refuelling are considered, examining fuel inflow systems and tank components. Areas in which further technological development is needed are addressed, indicating present analytical and experimental undertakings and planned projects.

#### A87-38001# **ELECTRIC PROPULSION FOR ORBIT TRANSFER - A** NAVSTAR CASE STUDY (HAS ELECTRIC PROPULSION'S

TIME COME?) JESS M. SPONABLE (USAF, Washington, DC) and JAY P. PENN (Aerospace Corp., El Segundo, CA) AlAA, DGLR, and JSASS, International Electric Propulsion Conference, 19th, Colorado Springs, CO, May 11-13, 1987. 12 p. (AIAA PAPER 87-0985)

This study assesses the viability and cost of using electric propulsion to transfer future global positioning system satellites from shuttle parking orbits to mission orbits. Transportation-to-orbit life cycle costs of a xenon-ion and ammonia arcjet-propelled electric-orbital transfer vehicle (EOTV) are compared to those of a conventional (PAM-DII) chemical upper stage currently on contract. Use of the EOTV in lieu of this upper stage can potentially reduce the Space Shuttle cargo element mass by 73 percent and the transport to orbit life cycle cost by as much as 61 percent, or \$21 million per flight while still meeting a 90-day flight time Author requirement.

#### A87-38003#

#### THE USE OF ELECTRIC PROPULSION ON LOW EARTH **ORBIT SPACECRAFT**

A. R. MARTIN and M. T. CRESDEE (Culham Laboratory, Abingdon, AIAA, DGLR, and JSASS, International Electric Propulsion Conference, 19th, Colorado Springs, CO, May 11-13, 1987. 10 p. Research supported by the British National Space Centre. refs

(AIAA PAPER 87-0989)

In the past, in the United Kingdom the analysis of missions for electric propulsion systems has been concerned with north-south station keeping of a satellite in a geostationary orbit, orbit raising of spacecraft from low earth orbit to geostationary orbit, and interplanetary missions to regions of the solar system outside the gravitational influence of the earth. A further class of mission not discussed as yet is the application of electric propulsion to systems operating in low earth orbit, and this is the subject of the present paper. In particular, the different elements of the United States of America/International Space Station are considered. This is appropriate at the present time as a result of the European Author Columbus activities on the various station elements.

A87-38004\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

#### GEOSYNCHRONOUS EARTH ORBIT BASE PROPULSION -**ELECTRIC PROPULSION OPTIONS**

B. PALASZEWSKI (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) AIAA, DGLR, and JSASS, International Electric Propulsion Conference, 19th, Colorado Springs, CO, May 11-13, 1987. 13 p. refs (AIAA PAPER 87-0990)

Electric propulsion and chemical propulsion requirements for a geosynchronous earth orbit (GEO) base were analyzed. The base is resupplied from the Space Station's low earth orbit. Orbit-transfer nodal-regression Delta-Vs and orbit-maintenance Delta-Vs were considered. For resupplying the base, a cryogenic oxygen/hydrogen (O2/H2) orbital transfer vehicle (OTV) is currently-baselined. Comparisons of several electric propulsion options with the O2/H2 OTV were conducted. Propulsion requirements for missions related to the GEO base were also analyzed. Payload data for the GEO missions were drawn from current mission data bases. Detailed electric propulsion module designs are presented. Mission analyses and propulsion analyses for the GEO-delivered payloads are included.

#### A87-38015#

#### A UK LARGE DIAMETER ION THRUSTER FOR PRIMARY **PROPULSION**

A. R. MARTIN, A. BOND, K. E. LAVENDER, M. S. HARVEY, and P. M. LATHAM (Culham Laboratory, Abingdon, England) AIAA, DGLR, and JSASS, International Electric Propulsion Conference, 19th, Colorado Springs, CO, May 11-13, 1987. 10 p. Research supported by the British National Space Centre. refs (AIAA PAPER 87-1031)

Attention is given to recent research efforts in the UK concerning the use of ion thrusters for orbit-raising of LEO platforms, for large spacecraft drag compensation, and for general space system control and positioning tasks; these applications require thrust levels of a few hundred mN. Development work has accordingly concentrated on a 25-cm diameter Kaufman-type ion thruster with a nominal output of 200 mN, using Xe as a propellant. Initial test results are presented.

#### A87-38016#

#### CP/MPS - CONTAINED PLASMA MAGNETIC PROPULSION SYSTEM: AN ADVANCED PROPULSION CONCEPT

J. M. MCCANNEY (Satellite Technology, Inc., Saint Paul, MN) AIAA, DGLR, and JSASS, International Electric Propulsion Conference, 19th, Colorado Springs, CO, May 11-13, 1987. 8 p. Research supported by Satellite Technology, Inc. refs (AIAA PAPER 87-1042)

A new concept for an electric propulsion system is presented which combines small physical size with high current densities to produce usable propulsion for satellite docking, remote manipulation of satellites and sensitive payloads, station keeping, space tug or orbital transfer (OTV) and for a transatmospheric vehicle (TAV) which is gyro-stabilized. The design has evolved over the past five years to its present state. The concept is described and placed into perspective with state of the art MPD and electric propulsion devices.

A87-38569\* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

## ELECTRODYNAMIC PLASMA MOTOR/GENERATOR

JAMES E. MCCOY (NASA, Johnson Space Center, Houston, TX) IN: Tethers in space; Proceedings of the International Conference, Arlington, VA, Sept. 17-19, 1986 . San Diego, CA, Univelt, Inc., 1987, p. 91-115. (AAS PAPER 86-210)

The Plasma Motor/Generator Proof of Function (PMG/POF) experiment, a low-cost payload for flight aboard the Shuttle Orbiter using the Hitchhiker G carrier, is discussed. The primary objective of this experiment is to verify that hollow cathode plasma sources can couple electric currents from either end of a long wire moving

through the space plasma in LEO into and through that plasma to produce a PMG circuit. The support structure and the electrical components of the experiment are described. The experimental operation is discussed, including the calibration, experimental measurements, and follow-on missions.

A87-38572\* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

#### PLASMA MOTOR/GENERATOR REFERENCE SYSTEM **DESIGNS FOR POWER AND PROPULSION**

JAMES E. MCCOY (NASA, Johnson Space Center, Houston, TX) IN: Tethers in space; Proceedings of the International Conference, Arlington, VA, Sept. 17-19, 1986 . San Diego, CA, Univelt, Inc., 1987, p. 439-452.

(AAS PAPER 86-229)

Four Plasma Motor/Generator (PMG) Reference Systems, hollow cathode-based versions of the electrodynamic tether concept which are to be used in study and analysis of future propulsion and power applications, are discussed. These systems are equally applicable for use as electric generators to provide power to a spacecraft or as electric motors using power from the spacecraft. Operating at relatively high current and low voltage, the PMGs avoid requirements for technological advances to handle very high voltages. Permanent deployment with passive I x B control of tether dynamics eliminates the complexity and weight of a TSS style tether reel. A 20 kW PMG uses 10 km of number two aluminum wire, weighs 1200 kg, and has an electrical efficiency of 93 percent. A larger 200 kW system uses 20 km of number 00 aluminum wire, weighs 4200 kg, and operates at 87 percent efficiency.

C.D.

#### A87-38778\* Hamilton Standard, Windsor Locks, Conn. MAINTENANCE COMPONENTS FOR SPACE STATION LONG LIFE FLUID SYSTEMS

JOHN B. GREENE, JR., GEORGE J. ROEBELEN, JR. (United Technologies Corp., Hamilton, Standard Div., Windsor Locks, CT), and JAMES W. OWEN (NASA, Marshall Space Flight Center, Huntsville, AL) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986 . Warrendale, PA. Society of Automotive Engineers, Inc., 1986, p. 825-833. (SAE PAPER 861005)

The Space Station elements or modules will maintain thermal conditioning by way of fluid systems. Because of the Station's 20 year minimum orbital lifetime, these fluid system designs must allow for on-orbit maintenance. This paper describes the maintenance assessment of the various Space Station thermal control system options, their components and the recommended maintenance approach for each. The design and utilization of the primary fluid isolation servicing method, the Maintenance Disconnect Valve (MMDV) and the effects of selecting different levels for the orbital replacement unit (ORU) are also presented.

#### A87-38785 SYMPOSIUM ON MICROGRAVITY FLUID MECHANICS, PROCEEDINGS OF THE WINTER ANNUAL MEETING, ANAHEIM, CA, DEC. 7-12, 1986

D. J. NORTON, ED. (Houston Area Research Center, TX) Symposium sponsored by ASME. New York, American Society of Mechanical Engineers, 1986, 77 p. For individual items see A87-38786 to A87-38797.

Papers are presented on the development of two-phase computer codes for microgravity applications, diffusion flame extinction in slow convective flow under microgravity environment, a differential approach to heat pipe priming in microgravity, an experimental study using flow visualization on the effect of an acoustic field on heat transfer, and equilibrium fluid interfaces in the absence of gravity. Consideration is given to microcirculatory fluid dynamics in weightlessness and simulated weightlessness, zero-G fluid mechanics in animals and man, cardiovascular adaptation to zero-G, microgravity-induced fluid and electrolyte balance changes, and continuous flow electrophoresis in

microgravity. Additional papers are on Space Station fluid management systems, low-G fluid motion test and analysis, the transient flow analysis and testing of the Space Shuttle Reaction Control System's low-G propellant acquisition system, and propellant tank forces resulting from fluid motion in a low-gravity field.

#### A87-41122#

#### 1987 STATUS REPORT - UNITED STATES AIR FORCE ELECTRIC PROPULSION RESEARCH AND DEVELOPMENT

ROBERT D. MEYA and TONY H. Q. NGUYEN (USAF, Astronautics Laboratory, Edwards AFB, CA) AIAA, DGLR, and JSASS, International Electric Propulsion Conference, 19th, Colorado Springs, CO, May 11-13, 1987. 14 p. refs (AIAA PAPER 87-1036)

The Air Force Astronautics Laboratory (AFAL) is currently developing electric propulsion technology to meet USAF and DOD requirements for military space missions. The AFAL's three-tiered R&D program is presented. In order of priority, the first tier is the space demonstration of a space-qualified 30-kWe-class arcjet propulsion system, while the second tier is the continued industrial development of arcjet technology to increase specific impulse and lifetime; the third tier is the continued university development of steady-state multimegawatt MPD thrusters to guarantee the availability of MPD technology upon USAF deployment of operational multimegawatt space power supplies. K.K.

**A87-41575\*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

#### ADVANCED PROPULSION ACTIVITIES IN THE USA

P. W. GARRISON (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) (IAF, International Astronautical Congress on Space: New Opportunities for all People, 37th, Innsbruck, Austria, Oct. 4-11, 1986) Acta Astronautica (ISSN 0094-5765), vol. 16, 1987, p. 357-366. refs

An evaluation is made of technology development prospects for launch vehicle, orbit transfer vehicle, satellite, and planetary exploration spacecraft propulsion systems being contemplated by NASA and its research contractors. Attention is given to such electric propulsion systems as arcjet, pulsed plasma, ion, and resistojet thrusters, as well as to solar thermal heat exchanger powerplants, beamed energy propulsion systems, and ultra-advanced nuclear fission and fusion propulsion concepts.

O.C.

## A87-41615\*# Colorado Univ., Boulder. INADEQUACY OF SINGLE-IMPULSE TRANSFERS FOR PATH CONSTRAINED RENDEZVOUS

S. A. STERN (Colorado, University, Boulder) and K. M. SOILEAU (NASA, Johnson Space Center, Houston, TX) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 24, May-June 1987, p. 282-284. refs

The use of single-impulse techniques to maneuver from point to point about a large space structure (LSS) with an arbitrary geometrical configuration and spin is examined. Particular consideration is given to transfers with both endpoints on the forbidden zone surface. Clohessy-Wiltshire equations of relative motion are employed to solve path constrained rendezvous problems. External and internal transfers between arbitrary points are analyzed in terms of tangential departure and arrival conditions. It is observed that single-impulse techniques are inadequate for transferring about the exterior of any LSS; however, single-impulse transfers are applicable for transfers in the interior of LSSs. It is concluded that single-impulse transducers are not applicable for path constrained rendezvous guidance.

#### A87-42680

### STATUS AND TENDENCIES FOR LOW TO MEDIUM THRUST PROPULSION SYSTEMS

HELMUT HOPMANN, RICHARD PITT, MANFRED SCHWENDE, and HELMUT ZEWEN (Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany) IAF, International Astronautical Congress,

37th, Innsbruck, Austria, Oct. 4-11, 1986. 37 p. refs (IAF PAPER 86-162; MBB-UR-877-86-PUB)

A review of ESA's goals through the year 2020 reveals that the category of low to medium thrust propulsion systems will be of major importance in the future. Propulsion systems for satellites and probes are considered as well as those for orbital maneuvering and transfer vehicles. Space Station programs like Columbus will require longer life components and increased modularity while manned launch vehicles such as Ariane V with Hermes or space planes such as HOTOL will demand higher safety and reliability requirements as well as maximum reuseability.

K.K.

## A87-43027\*# General Dynamics Corp., San Diego, Calif. EVALUATION OF CRYOGENIC SYSTEM TEST OPTIONS FOR THE OTV ON-ORBIT PROPELLANT DEPOT

JOHN R. SCHUSTER, T. JAMES ALTON (General Dynamics Corp., Space Systems Div., San Diego, CA), NORMAN S. BROWN, and UWE HUETER (NASA, Marshall Space Flight Center, Huntsville, AL) AIAA, Thermophysics Conference, 22nd, Honolulu, HI, June 8-10, 1987. 12 p.

(AIAA PAPER 87-1498)

Future space missions to geosynchronous, lunar, and planetary orbits will require an orbital depot for stockpiling propellants. This depot will provide long-term storage of cryogens, requiring new technologies for fluid management in microgravity and further development of thermal management technologies for minimization of cryogen boiloff. Preliminary evaluations have been made to define a test program approach for reducing technical risk through verifying performance models and building a base of engineering data for depot design. A number of testing options were defined and evaluated, leading to selection of ground testing combined with an orbital systems test. Ground testing is inadequate because of critical microgravity concerns; extending testing aboard the Space Station was eliminated because the data would not be available soon enough to benefit the propellant depot design. The orbital test would either be a short-term test carried out in the cargo bay of the Space Shuttle Orbiter using a nonhazardous cryogen or a longer term test carried out with hydrogen aboard a free-flying experiment orbited with an expendable launch vehicle.

Autho

#### A87-44832#

#### ON-ORBIT CRYOGENIC FLUID MANAGEMENT EXPERIMENTAL DATA REQUIREMENTS USING REFEREE FLUIDS

R. S. RUDLAND (Martin Marietta Corp., Denver, CO) AIAA, Thermophysics Conference, 22nd, Honolulu, HI, June 8-10, 1987. 6 p.

(AIAA PAPER 87-1559)

A review of testing requirements for cryogenic fluid management designs in space show that liquid nitrogen and liquid helium can be used in a limited way to obtain data for liquid oxygen and liquid hydrogen fluid tanker designs. Current testing at Martin Marietta with liquid nitrogen is useful for developing experience with cryogenic transfer concepts. Many tests are still needed on the ground, in drop tower tests, in the KC-135, and in space to eliminate weaknesses in the fluid transfer system design. Author

#### A87-45190#

#### MODELING OF FLUID TRANSFER IN ORBIT

IN-KUN KIM and F. O. BENNETT, JR. (General Dynamics Corp., Space Systems Div., San Diego, CA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 23rd, San Diego, CA, June 29-July 2, 1987. 6 p. refs (AIAA PAPER 87-1763)

Transfer of cryogenic propellants in orbit using a total communication, surface tension liquid acquisition device (LAD) has been analytically modeled. The LAD is a symmetrical, four-channel, screen-covered system feeding a collector manifold at the tank outlet. In the present study, the computer program optimizes the acquisition channels based on an assumed acquisition rate and estimates total time required for transfer. The model addresses such previously unreported issues as channel sizing, effect of liquid

'uncovering' screen surfaces, effect of diffuser location, etc. The program uses a model of the instantaneous relationship between uncovered screen area and tank ullage volume. The study demonstrates that a channel/screen-type LAD can be sized and optimized if the acquisition requirements and constraints are

## A87-45191\* Boeing Aerospace Co., Seattle, Wash. SPACE-BASED OTV BOILOFF DISPOSITION

C. L. WILKINSON (Boeing Aerospace Co., Seattle, WA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 23rd, San Diego, CA, June 29-July 2, 1987. 7 p. (Contract NAS8-36107)

(AIAA PAPER 87-1767)

The boiloff and chilldown problem associated with a reusable space-based orbital transfer vehicle (OTV) that uses the Space Station as a base of operations is considered. Various boiloff and chilldown gas disposal options are examined, and a recommended approach is defined on the basis of least life-cycle cost. In accordance with this approach, half of the gaseous hydrogen is used to generate 3.87 kW, while the remaining hydrogen and the resulting water are remotely vented using the Orbital Maneuvering Vehicle.

#### A87-45196#

#### HYDROGEN-OXYGEN THRUSTER WITH NO PRODUCTS OF **COMBUSTION IN EXHAUST PLUME**

GREGORY S. HOSFORD and KEN CLODFELTER (Sundstrand Corp., Sundstrand Advanced Technology Group, Rockford, IL) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 23rd, San Diego, CA, June 29-July 2, 1987. 4 p. (AIAA PAPER 87-1775)

A bipropellant jet thruster concept is proposed which has a high specific impulse without the disadvantages of combustion products in the exhaust gas stream or the weight penalties of electrical energy storage. It is shown how the present concept can be integrated with an electrolyzer reactant supply system such as the one proposed for the Space Station. The clean effluent jet in this application has the benefit of no net oxygen consumption because all the oxygen is contained in the water combustion product, which is captured and recirculated to the reactant supply

#### A87-45255\*# Rockwell International Corp., Canoga Park, Calif. SPACE STATION PROPULSION SYSTEM TEST BED AND CONTROL SYSTEM TESTING RESULTS

A. M. NORMAN, G. L. BRILEY, L. H. NAVE, J. F. PAVLINSKY (Rockwell International Corp., Rocketdyne Div., Canoga Park, CA), and S. ALLUMS (NASA, Marshall Space Flight Center, Huntsville, AL) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 23rd, San Diego, CA, June 29-July 2, 1987. 12 p. (Contract NAS8-36418) (AIAA PAPER 87-1858)

The test bed fabricated to demonstrate hydrogen/oxygen propulsion technology readiness for the IOC Space Station application is described and test results are presented. The reliability and safety of the O2/H2 system was demonstrated with blowdowns and thruster firings. The flexibility of the system was demonstrated through the addition of an electrolysis supply module.

A87-45256\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

#### CONCEPTUAL DESIGN AND INTEGRATION OF A SPACE STATION RESISTOJET PROPULSION ASSEMBLY

R. R. TACINA (NASA, Lewis Research Center, Cleveland, OH) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 23rd, San Diego, CA, June 29-July 2, 1987. 13 p. Previously announced in STAR as N87-20378. refs (AIAA PAPER 87-1860)

The resistojet propulsion module is designed as a simple, long life, low risk system offering operational flexibility to the space station program. It can dispose of a wide variety of typical space

station waste fluids by using them as propellants for orbital maintenance. A high temperature mode offers relatively high specific impulse with long life while a low temperature mode can propulsively dispose of mixtures that contain oxygen or hydrocarbons without reducing thruster life or generating particulates in the plume. A low duty cycle and a plume that is confined to a small aft region minimizes the impacts on the users. Simple interfaces with other space station systems facilitate integration. It is concluded that there are no major obstacles and many advantages to developing, installing, and operating a resistojet propulsion module aboard the Initial Operational Capability (IOC) space station.

#### A87-45259\*# Booz-Allen and Hamilton, Inc., Washington, D. C. THE IMPACT OF INTEGRATED WATER MANAGEMENT ON THE SPACE STATION PROPULSION SYSTEM

GEORGE R. SCHMIDT (Booz-Allen and Hamilton, Inc., Washington, DC) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 23rd, San Diego, CA, June 29-July 2, 1987, 9 p. (Contract NAS8-36526)

(AIAA PAPER 87-1864)

The water usage of elements in the Space Station integrated water system (IWS) is discussed, and the parameters affecting water balance and the water-electrolysis propulsion-system requirements are considered. With nominal IWS operating characteristics, extra logistic water resupply (LWR) is found to be unnecessary in the satisfaction of the nominal propulsion requirements. With the consideration of all possible operating characteristics, LWR will not be required in 65.5 percent of the cases, and for 17.9 percent of the cases LWR can be eliminated by controlling the stay time of the Shuttle Orbiter. R.R.

#### A87-45260#

#### ANALYTICAL AND EXPERIMENTAL MODELING OF ZERO/LOW GRAVITY FLUID BEHAVIOR

TSO-PING YEH (Ford Aerospace and Communications Corp., Palo Alto, CA) and GEORGE F. ORTON (McDonnell Douglas Corp., Saint Louis, MO) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 23rd, San Diego, CA, June 29-July 2, 1987. 8 p. (AIAA PAPER 87-1865)

A combined analytical and experimental study has been conducted to develop methods to predict the fluid behavior under zero/low-gravity conditions. Analytical models to predict stable equilibrium liquid free surface shape, transient liquid reorientation characteristics, liquid pumping capability of various channel configuratins, and liquid settling and slosh dynamics are presented. Experimental methods (zero-gravity drop tower and KC-135 airplane flight tests) used to simulate the fluid behavior are also discussed. Good agreement was found between the analytical models and the test data. The analytical models and the fundamental zero-gravity fluid behavior data are critical to the design of advanced fluid management systems and point sensor propellant gaging systems for space vehicles.

#### A87-45287#

#### SPACE STATION OPTIONS FOR CONSTRUCTING ADVANCED SOLAR SAILS CAPABLE OF MULTIPLE MARS MISSIONS

J. M. GARVEY (McDonnell Douglas Astronautics Co., Huntington ÀIAA, SAE, ASME, and ASEE, Joint Propulsion Beach, CA) Conference, 23rd, San Diego, CA, June 29-July 2, 1987. 9 p.

(AIAA PAPER 87-1902)

This paper considers the potential for using a Space Station in low earth orbit to build reusable solar sails that are capable of delivering significanat payloads to Mars. Operationally, the use of a long (10-150 km) tether provides a method for overcoming the obstacles of atmospheric drag, interference with the Space Station, logistics, and placement of the finished sail into a functional orbit. Because the sails are designed for and built in space, they have a much higher performance than earth-launched versions, which must also tolerate the harsher regimes associated with packaging,

launch, and deployment. The sail baselined in this paper can deliver over thirty metric tons of payload to Mars during close approach.

Author

A87-45311#

#### LIQUID PROPULSION TECHNOLOGY FOR EXPENDABLE AND STS LAUNCH VEHICLE TRANSFER STAGES

KIMBERLY A. ENNIX and MARK COLEMAN (USAF, Astronautics Laboratory, Edwards AFB, CA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 23rd, San Diego, CA, June 29-July 2, 1987. 6 p.

(AIAA PAPER 87-1934)

Liquid propulsion design options for orbital transfer vehicles (OTV) were analyzed for various upper stage applications. High and low pressure earth storable propellant system technology and high performance, low thrust cryogenic concepts were investigated for payload stages of 39,000 lbm to 57,300 lbm low earth orbit (LEO) class launch vehicles. The design criteria was baselined for a specific impulse of 340 seconds and mass fraction of 0.90 with LEO altitude of 110 nm. Performance results were computed for a range of mass fraction between 0.88 and 0.92 and ISP between 320 and 500 seconds.

#### A87-45357#

#### MIXING-INDUCED ULLAGE CONDENSATION AND FLUID **DESTRATIFICATION**

JERE S. MESEROLE, OGDEN S. JONES, SCOTT M. BRENNAN, and ANTHONY FORTINI (Boeing Aerospace Co., Seattle, WA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 23rd, San Diego, CA, June 29-July 2, 1987. 12 p. refs (AIAA PAPER 87-2018)

Forced mixing may be required for on-orbit storage and transfer of cryogens. To provide applicable data on jet-induced mixing, an experiment was conducted in which an axial jet mixer promoted condensation of the ullage and lowered the pressure in a subscale cylindrical tank partially filled with Freon 11. The test objectives were to (1) determine the transient condensation and heat transfer rates at the liquid-vapor interface as a function of jet parameters, (2) quantify the important factors affecting mixing efficiency, and (3) compare mixing times to previous mixing data based on acid-base neutralization and dye dispersion. The variation of interface heat transfer coefficient with changes in jet Reynolds number was consistent with existing correlations based on measurements of steady-state rates of mixing-induced condensation of steam. Mixing times based on tank pressure decay were correlated with jet momentum flux, although buoyancy effects made it difficult to extrapolate all the results to low gravity. Mixers with large diameter nozzles and low flow rates required the most time and least amount of energy to destratify the fluid. Dimensionless mixing times agreed with comparable acid-base neutralization data, but not with dye dispersion data.

#### LIQUID PROPELLANT TANK ULLAGE BUBBLE DEFORMATION AND BREAKUP IN LOW GRAVITY REORIENTATION

JAMES J. DER and CHRISTINE L. STEVENS (Aerospace Corp., Los Angeles, CA) AlAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 23rd, San Diego, CA, June 29-July 2, 1987. 9 p.

(Contract F04701-85-C-0086-P00016)

(AIAA PAPER 87-2021)

Collapse, geyser formation, and breakup of a reorienting ullage bubble in liquid propellant tanks under low gravity have been studied numerically. The response of liquid propellant in a partially filled spacecraft tank under a suddenly imposed external acceleration has been examined. The similitude variables developed in a previous paper for correlating unsteady numerical and experimental data of the bubble motion are applicable here for the kinetics of the bubble surface. When the bubble is initially situated further from the new top surface, some of the energy is dissipated in fragmenting the bubble. Also, there is more liquid between the bubble and the wall. Thus, the further the initial location of the

ullage is from the new top, the weaker the liquid jet striking the wall. For the case of larger ullage, there is less liquid participation in the gevser formation, and the jet is therfore weaker. With an ullage as large as 30 percent, the geyser can at most barely penetrate the bubble.

#### **AR7-45439#**

#### NERVA DERIVED NUCLEAR ORBIT TRANSFER SYSTEM

TAL K. SULMEISTERS (Martin Marietta Corp., Denver, CO) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 23rd, San Diego, CA, June 29-July 2, 1987. 6 p. (AIAA PAPER 87-2155)

A version of the NERVA nuclear rocket engine is compared to a chemical system in terms of mission applications and costs. A space transportation architecture study mission model was used to evaluate mission applications; the missions included integral, orbit maneuvering vehicle, orbit transfer vehicle, and planetary. The stage design and operation are discussed. Radiation decay levels were examined; it is determined that radiation levels are within acceptable levels for unmanned and manned operations. The life cycle costs for the nuclear and chemical orbit transfer systems are analyzed. The effects of variations in payload weight, stage weight, stage performance, and costs on nuclear and chemical stages are investigated. The data reveal that the nuclear stage is safer, and more efficient and reliable at a lower cost, than the chemical stage for the same mission.

A87-48572\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

#### THERMODYNAMIC ANALYSIS AND SUBSCALE MODELING OF SPACE-BASED ORBIT TRANSFER VEHICLE CRYOGENIC PROPELLANT RESUPPLY

DAVID M. DEFELICE and JOHN C. AYDELOTT (NASA, Lewis Research Center, Cleveland, OH) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 23rd, San Diego, CA, June 29-July 2, 1987. 21 p. Previously announced in STAR as N87-22949.

(AIAA PAPER 87-1764)

The resupply of the cryogenic propellants is an enabling technology for spacebased orbit transfer vehicles. As part of the NASA Lewis ongoing efforts in microgravity fluid management, thermodynamic analysis and subscale modeling techniques were developed to support an on-orbit test bed for cryogenic fluid management technologies. Analytical results have shown that subscale experimental modeling of liquid resupply can be used to validate analytical models when the appropriate target temperature is selected to relate the model to its prototype system. Further analyses were used to develop a thermodynamic model of the tank chilldown process which is required prior to the no-vent fill operation. These efforts were incorporated into two FORTRAN programs which were used to present preliminary analytical results.

National Aeronautics and Space Administration. A87-49615\*# Ames Research Center, Moffett Field, Calif.

#### SYNERGETIC PLANE-CHANGE CAPABILITY OF A CONCEPTUAL AEROMANEUVERING-ORBITAL-TRANSFER **VEHICLE**

GENE P. MENEES (NASA, Ames Research Center, Moffett Field, CA), JOHN F. WILSON (Sterling Software, Palo Alto, CA), and HENRY G. ADELMAN (Eloret Institute, Sunnyvale, CA) IN: AIAA Atmospheric Flight Mechanics Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1987, p. 388-397. refs (AIAA PAPER 87-2565)

The flight strategy for a general low-earth orbit plane-change is analyzed for a conceptual, high-lift, aeromaneuvering-orbital-transfer vehicle, and applied to the important case of the 45 deg plane-inclination change. The study focuses on two principle methods: (1) the procedure to obtain a change in the inclination of the vehicle's orbital plane, and (2) the full rendezvous procedure. Optimal trajectories for minimal propellant use during the synergetic aerotransit are

developed, which incorporate best estimates of constraints imposed by reusable thermal-protection requirements and human tolerance to g-load levels. The performance capability for one-way payload delivery to the target orbit is analyzed in detail and the capability for return to the base orbit demonstrated.

#### A87-49617#

#### COMBINING SPACE-BASED PROPULSIVE MANEUVERS AND **AERODYNAMIC MANEUVERS TO ACHIEVE OPTIMAL ORBITAL TRANSFER**

JOHN M. HANSON (Anser, Space Systems Div., Arlington, VA) IN: AIAA Atmospheric Flight Mechanics Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1987, p. 406-416. refs (AIAA PAPER 87-2567)

This paper presents solutions to the problem of optimal atmospheric turning. The main purpose, however, is to demonstrate how much the required velocity change can be reduced by combining aerodynamic and propulsive maneuvers during the orbital transfer. Comparisons are given for purely propulsive maneuvers, maneuvers using aerodrag only (no lift), maneuvers with all plane change occurring in the atmosphere, and maneuvers combining atmospheric and propulsive impulses optimally to achieve minimum velocity change requirements. Results are presented for vehicles with a range of maximum lift-to-drag ratios. All cases are for transfers between circular orbits.

National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

#### PRELIMINARY PERFORMANCE CHARACTERIZATIONS OF AN **ENGINEERING MODEL MULTIPROPELLANT RESISTOJET** FOR SPACE STATION APPLICATION

W. EARL MORREN, THOMAS W. HAAG, JAMES S. SOVEY (NASA, Lewis Research Center, Cleveland, OH), and STUART S. HAY (Purdue University, West Lafayette, IN) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 23rd, San Diego, CA, June 29-July 2, 1987. 24 p. Previously announced in STAR as N87-23821. refs (AIAA PAPER 87-2120)

Presented are the results of a program to describe the operational characteristics of an engineering model multipropellant resistojet for application as an auxiliary propulsion system for the space station. Performance was measured on hydrogen, helium, methane, water (steam), nitrogen, air, argon, and carbon dioxide. Thrust levels ranged from 109 to 355 mN, power levels ranged from 167 to 506 W, and specific impulse values ranged from 93 to 385 sec, depending on the propellant, chamber pressure, and heater current level selected. Detailed thermal maps of the heater and heat exchanger were also obtained for operation with carbon dioxide. Author

#### A87-50509\*# Washington State Univ., Pullman. **AEROASSISTED ORBITAL MANEUVERING USING LYAPUNOV** OPTIMAL FEEDBACK CONTROL

WALTER J. GRANTHAM (Washington State University, Pullman) and BYOUNG-SOO LEE IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 2. New York, American Institute of Aeronautics and Astronautics, 1987, p. 994-1000. refs

(Contract NCA2-191)

(AIAA PAPER 87-2464)

A Liapunov optimal feedback controller incorporating a preferred direction of motion at each state of the system which is opposite to the gradient of a specified descent function is developed for aeroassisted orbital transfer from high-earth orbit to LEO. The performances of the Liapunov controller and a calculus-of-variations open-loop minimum-fuel controller, both of which are based on the 1962 U.S. Standard Atmosphere, are simulated using both the 1962 U.S. Standard Atmosphere and an atmosphere corresponding to the STS-6 Space Shuttle flight. In the STS-6 atmosphere, the calculus-of-variations open-loop controller fails to exit the atmosphere, while the Liapunov controller achieves the optimal minimum-fuel conditions, despite the + or - 40 percent fluctuations in the STS-6 atmosphere. R.R.

#### A87-52247\*# Washington Univ., St. Louis, Mo. TEMPERATURE FIELDS DUE TO JET INDUCED MIXING IN A TYPICAL OTV TANK

J. I. HOCHSTEIN, HYUN-CHUL JI (Washington University, Saint Louis, MO), and J. C. AYDELOTT (NASA, Lewis Research Center, Cleveland, OH) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 23rd, San Diego, CA, June 29-July 2, 1987. 11 p. refs

(Contract NAG3-578)

(AIAA PAPER 87-2017)

The Eclipse Code is being developed as a general tool for analysis of cryogenic propellant behavior in spacecraft tankage. The focus of the work being reported is on prediction of temperature fields due to introduction of a cold jet along the centerline of a typical Orbit Transfer Vehicle tank. A brief description of the formulations used for modeling heat transfer and turbulent flow is presented. Code performance is verified through comparison to experimental data for mixing in small scale tanks. An unexpected difficulty in computing long duration flows is reviewed. Preliminary results for a partially filled full scale tank are obtained by approximating the free surface by a spherical solid boundary.

Author

#### A87-54196

#### ION THRUSTERS ADVANCE

ANDREW WILSON Space (ISSN 0267-954X), vol. 3, July-Aug. 1987, p. 18, 19.

The development of ion engines for future space missions is discussed. The use of a 10-cm ion thruster system for satellite stationkeeping, the 25-cm thruster for the Comet Nucleus Sample Return mission, and the new xenon test facility are examined. Ion thrusters are applicable to geostationary comsats, the Columbus Polar Platform, the coorbiting platforms of the Space Station, and deep-space missions. A diagram of the T4 mercury thruster is presented.

#### N87-20375 Department of the Air Force, Washington, D.C. PROPELLANT TANK RESUPPLY SYSTEM Patent

THOMAS F. SCHWEICKERT, inventor (to Air Force) and GEORGE F. ORTON, inventor (to Air Force) 2 Sep. 1986 5 p Supersedes N85-13848, AD-D011288 (83 - 05, p 603) (AD-D012559; US-PATENT-4,609,169;

US-PATENT-APPL-SN-640636) Avail: US Patent and Trademark Office CSCL 211

The present invention relates generally to improvements in attitude control systems (ACS) for spacecraft and more particularly to a novel propellant tank resupply system and method for increasing ACS propellant usage capability through resupply of the ACS tanks during operation of the engines of the primary propulsion system.

N87-20378\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

#### CONCEPTUAL DESIGN AND INTEGRATION OF A SPACE STATION RESISTOJET PROPULSION ASSEMBLY

ROBERT R. TACINA 1987 19 p Prepared for presentation at the 23rd Joint Propulsion Conference, San Diego, Calif., 29 Jun. 21 Jul. 1987; sponsored in part by AIAA, SAE, ASME and ASEE (NASA-TM-89847; E-3483; NAS 1.15:89847) Avail: NTIS HC A02/MF A01 CSCL 21H

The resistojet propulsion module is designed as a simple, long life, low risk system offering operational flexibility to the space station program. It can dispose of a wide variety of typical space station waste fluids by using them as propellants for orbital maintenance. A high temperature mode offers relatively high specific impulse with long life while a low temperature mode can propulsively dispose of mixtures that contain oxygen or hydrocarbons without reducing thruster life or generating particulates in the plume. A low duty cycle and a plume that is confined to a small aft region minimizes the impacts on the users. Simple interfaces with other space station systems facilitate integration. It is concluded that there are no major obstacles and many advantages to developing, installing, and operating a resistojet propulsion module aboard the Initial Operational Capability (IOC) space station.

N87-21141\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

MICROGRAVITY FLUID MANAGEMENT SYMPOSIUM

Symposium held in Cleveland, Ohio, 9-10 225 p Sep. 1986

(NASA-CP-2465; E-3386; NAS 1.55:2465) Avail: NTIS HC A10/MF A01 CSCL 22A

The NASA Microgravity Fluid Management Symposium, held at the NASA Lewis Research Center, September 9 to 10, 1986, focused on future research in the microgravity fluid management field. The symposium allowed researchers and managers to review space applications that require fluid management technology, to present the current status of technology development, and to identify the technology developments required for future missions. The 19 papers covered three major categories: (1) fluid storage, acquisition, and transfer; (2) fluid management applications, i.e., space power and thermal management systems, and environmental control and life support systems; (3) project activities and insights including two descriptions of previous flight experiments and a summary of typical activities required during development of a shuttle flight experiment.

National Aeronautics and Space Administration. N87-21142\*# Marshall Space Flight Center, Huntsville, Ala.

ADVANCED LONG TERM CRYOGENIC STORAGE SYSTEMS NORMAN S. BROWN In NASA. Lewis Research Center Microgravity Fluid Management Symposium p 7-16 Apr. 1987 Avail: NTIS HC A10/MF A01 CSCL 22B

Long term, cryogenic fluid storage facilities will be required to support future space programs such as the space-based Orbital Transfer Vehicle (OTV), Telescopes, and Laser Systems. An orbital liquid oxygen/liquid hydrogen storage system with an initial capacity of approximately 200,000 lb will be required. The storage facility tank design must have the capability of fluid acquisition in microgravity and limit cryogen boiloff due to environmental heating. Cryogenic boiloff management features, minimizing Earth-to-orbit transportation costs, will include advanced thick multilayer vapor cooled shield insulation/integrated conductance support structures, and refrigeration/reliquefaction systems. Contracted study efforts are under way to develop storage system designs, technology plans, test article hardware designs, and develop plans for ground/flight testing. Author

N87-21143\*# General Dynamics Corp., San Diego, Calif. Space Systems Div.

#### LONG TERM CRYOGENIC STORAGE FACILITY SYSTEMS STUDY

In NASA, Lewis Research Center JOHN R. SCHUSTER Microgravity Fluid Management Symposium p 17-30 Avail: NTIS HC A10/MF A01 CSCL 22B

The Long Term Cryogenic Storage Facility Systems Study (LTCSFSS) is a Phase A study of a large capacity propellant depot for the space based, cryogenic orbital transfer vehicle. The study is being performed for Marshall Space Flight Center by General Dynamics Space Systems Division and has five principal objectives: (1) Definition of preliminary concept designs for four storage facility concepts; (2) Selection of preferred concepts through the application of trade studies to candidate propellant management system components; (3) Preparation of a conceptual design for an orbital storage facility; (4) Development of supporting research and technology requirements; and (5) Development of a test program to demonstrate facility performance. The initial study has been completed, and continuation activities are just getting under way to provide greater detail in key areas and accommodate changes in study guidelines and assumptions.

#### N87-21144\*# Beech Aircraft Corp., Boulder, Colo. SPACE STATION EXPERIMENT DEFINITION: LONG TERM CRYOGENIC FLUID STORAGE

DAVID H. RIEMER In NASA. Lewis Research Center Microgravity Fluid Management Symposium p 31-42 Apr. 1987 Avail: NTIS HC A10/MF A01 CSCL 22B

A preliminary design of an experiment to demonstrate and evaluate long-term cryogenic fluid storage and transfer technologies has been performed. This Long-Term Cryogenic Fluid Storage (LTCFS) experiment is a Technology Development Mission (TDM) experiment proposed by the NASA Lewis Research Center to be deployed on the Initial Operational Capability (IOC) space station. Technologies required by future orbital cryogenic systems such as Orbital Transfer Vehicles (OTV's) were defined, and critical technologies requiring demonstration were chosen to be included in the experiment. A three-phase test program was defined to test the following types of technologies: (1) Passive Thermal Technologies; (2) Fluid Transfer Technologies; and (3) Active Refrigeration Technologies. The development status of advanced technologies required for the LTCFS experiment is summarized, including current, past and future programs.

N87-21145\*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif. HELIUM TECHNOLOGY ISSUES

PETER KITTEL In NASA. Lewis Research Center Microgravity Fluid Management Symposium p 43-55 Avail: NTIS HC A10/MF A01 CSCL 22A

A number of future space missions require liquid helium for cooling scientific payloads. These missions will require the long term storage and resupply of liquid helium at temperatures of 1.4 - 2.1 Kelvin. In addition, some of the proposed instruments will require refrigeration to temperatures as low as 50 mK. A variety of liquid helium based refrigerator systems could provide this subkelvin cooling. The status of helium storage and refrigeration technologies and of several alternative technologies is presented here along with areas where further research and development are needed. (Helium resupply technologies are the topic of another presentation at this symposium). The technologies covered include passive and dynamic liquid helium storage, alternatives to liquid helium storage, He -3 refrigerators, He -3/He -4 dilution refrigerators, and alternative sub-kelvin coolers.

#### N87-21146\*# Boeing Aerospace Co., Seattle, Wash. OVERVIEW: FLUID ACQUISITION AND TRANSFER

JERE S. MESEROLE In NASA. Lewis Research Center Microgravity Fluid Management Symposium p 57-65 Avail: NTIS HC A10/MF A01 CSCL 22A

This brief overview introduced the symposium session on microgravity fluid acquisition and transfer. It states the objective of NASA efforts in this technology and the approach being taken in the technology program. The problems are outlined and various methods for low-gravity fluid acquisition and transfer are summarized. Applications for the technology are described and an assessment of the current state of the art is presented. NASA and DOD on-going and planned programs are listed.

#### N87-21147\*# Massachusetts Inst. of Tech., Cambridge. THE COUPLED DYNAMICS OF FLUIDS AND SPACECRAFT IN LOW GRAVITY AND LOW GRAVITY FLUID MEASUREMENT

R. JOHN HANSMAN, LEE D. PETERSON, and EDWARD F CRAWLEY In NASA. Lewis Research Center Microgravity Fluid Management Symposium p 67-84 Apr. 1987 Avail: NTIS HC A10/MF A01 CSCL 22A

The very large mass fraction of liquids stored on broad current and future generation spacecraft has made critical the technologies of describing the fluid-spacecraft dynamics and measuring or gauging the fluid. Combined efforts in these areas are described, and preliminary results are presented. The coupled dynamics of fluids and spacecraft in low gravity study is characterizing the parametric behavior of fluid-spacecraft systems in which interaction between the fluid and spacecraft dynamics is encountered. Particular emphasis is given to the importance of nonlinear fluid

free surface phenomena to the coupled dynamics. An experimental apparatus has been developed for demonstrating a coupled fluid-spacecraft system. In these experiments, slosh force signals are fed back to a model tank actuator through a tunable analog second order integration circuit. In this manner, the tank motion is coupled to the resulting slosh force. Results are being obtained in 1-g and in low-g (on the NASA KC-135) using dynamic systems nondimensionally identical except for the Bond numbers. Author

### N87-21148\*# Washington Univ., St. Louis, Mo. NUMERICAL MODELLING OF CRYOGENIC PROPELLANT **BEHAVIOR IN LOW-G**

JOHN I. HOCHSTEIN In NASA. Lewis Research Center Microgravity Fluid Management Symposium p 85-100

Avail: NTIS HC A10/MF A01 CSCL 22A

A partial survey is presented of recent research, sponsored by the NASA Lewis Research Center, into the computational modelling of cryogenic propellant behavior in a low gravity environment. This presentation is intended to provide insight into some of the specific problems being studied and into how these studies are part of an integrated plan to develop predictive capabilities. A brief description of the computational models developed to analyze jet induced mixing in cryogenic propellant tankage is presented along with representative results. Similar information is presented for a recent examination of on-orbit self-pressurization. A study of propellant reorientation has recently been initiated and preliminary results are included. The presentation concludes with a list of ongoing efforts and projected goals.

#### N87-21149\*# Boeing Aerospace Co., Kent, Wash. MIXING-INDUCED FLUID DESTRATIFICATION AND ULLAGE CONDENSATION

JERE S. MESEROLE, OGDEN S. JONES, and ANTHONY F. FORTINI (Anthony Enterprises, Federal Way, Wash.) In NASA. Lewis Research Center Microgravity Fluid Management Symposium Apr. 1987

Avail: NTIS HC A10/MF A01 CSCL 22A

In many applications, on-orbit storage and transfer of cryogens will require forced mixing to control tank pressure without direct venting to space. During a no-vent transfer or during operation of a thermodynamic vent system in a cryogen storage tank, pressure control is achieved by circulating cool liquid to the liquid-vapor interface to condense some of the ullage vapor. To measure the pressure and temperature response rates in mixing-induced condensation, an experiment has been developed using Freon 11 to simulate the two-phase behavior of a cryogen. A thin layer at the liquid surface is heated to raise the tank pressure, and then a jet mixer is turned on to circulate the liquid, cool the surface, and reduce the pressure. Many nozzle configurations and flow rates are used. Tank pressure and the temperature profiles in the ullage and the liquid are measured. Initial data from this ground test are shown correlated with normal-gravity and drop-tower dye-mixing data. Pressure collapse times are comparable to the dye-mixing times, whereas the times needed for complete thermal mixing are much longer than the dye-mixing times.

N87-21150\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

#### CRYOGENIC FLUID MANAGEMENT FLIGHT EXPERIMENT (CFMFE)

DAVID M. DEFELICE In its Microgravity Fluid Management Symposium p 119-124 Apr. 1987

Avail: NTIS HC A10/MF A01 CSCL 22A

Since its foundation, NASA has excelled in the study and development of microgravity fluid management technology. With the advent of space-based vehicles and systems, the use of and the ability to efficiently manage subcritical cryogens in the space environment has become necessary to our growing space program. The NASA Lewis Research Center is responsible for the planning and execution of a program which will provide advanced in-space cryogenic fluid management technology. A number of future space missions have been identified that will require or could benefit

from this technology. These technology needs have been prioritized and the Cryogenic Fluid Management Flight Experiment (CFMFE) is being designed to provide the experimental data necessary for the technological development effort.

National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SUPERFLUID HELIUM ON ORBIT TRANSFER (SHOOT)

MICHAEL J. DIPIRRO In NASA. Lewis Research Center Microgravity Fluid Management Symposium p 125-136 1987

Avail: NTIS HC A10/MF A01 CSCL 22A

A number of space flight experiments and entire facilities require superfluid helium as a coolant. Among these are the Space Infrared Telescope Facility (SIRTF), the Large Deployable Reflector (LDR), the Advanced X-ray Astrophysics Facility (AXAF), the Particle Astrophysics Magnet Facility (PAMF or Astromag), and perhaps even a future Hubble Space Telescope (HST) instrument. Because these systems are required to have long operational lifetimes, a means to replenish the liquid helium, which is exhausted in the cooling process, is required. The most efficient method of replenishment is to refill the helium dewars on orbit with superfluid helium (liquid helium below 2.17 Kelvin). To develop and prove the technology required for this liquid helium refill, a program of ground and flight testing was begun. The flight demonstration is baselined as a two flight program. The first, described in this paper, will prove the concepts involved at both the component and system level. The second flight will demonstrate active astronaut involvement and semi-automated operation. The current target date for the first launch is early 1991.

N87-21152\*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

### MICROGRAVITY FLUID MANAGEMENT IN TWO-PHASE

THERMAL SYSTEMS

RICHARD C. PARISH In NASA. Lewis Research Center Microgravity Fluid Management Symposium p 139-149

Avail: NTIS HC A10/MF A01 CSCL 22A

Initial studies have indicated that in comparison to an all liquid single phase system, a two-phase liquid/vapor thermal control system requires significantly lower pumping power, demonstrates more isothermal control characteristics, and allows greater operational flexibility in heat load placement. As a function of JSC's Work Package responsibility for thermal management of space station equipment external to the pressurized modules. prototype development programs were initiated on the Two-Phase Thermal Bus System (TBS) and the Space Erectable Radiator System (SERS). JSC currently has several programs underway to enhance the understanding of two-phase fluid flow characteristics. The objective of one of these programs (sponsored by the Microgravity Science and Applications Division at NASA Headquarters) is to design, fabricate, and fly a two-phase flow regime mapping experiment in the Shuttle vehicle mid-deck. Another program, sponsored by OAST, involves the testing of a two-phase thermal transoprt loop aboard the KC-135 reduced gravity aircraft to identify system implications of pressure drop variation as a function of the flow quality and flow regime present in a representative thermal system.

#### N87-21158\*# Martin Marietta Corp., Denver, Colo. SHUTTLE MIDDECK FLUID TRANSFER EXPERIMENT: **LESSONS LEARNED**

JAMES TEGART In NASA. Lewis Research Center Microgravity Fluid Management Symposium p 217-224 Apr. 1987 Avail: NTIS HC A10/MF A01 CSCL 22A

This presentation is based on the experience gained from having integrated and flown a shuttle middeck experiment. The experiment, which demonstrated filling, expulsion, and fluid behavior of a liquid storage system under low-gravity conditions, is briefly described. The advantages and disadvantages of middeck payloads compared to other shuttle payload provisions are discussed. A general approach to the integration process is described. The requirements for the shuttle interfaces--such as structures, pressurized systems, materials, instrumentation, and electrical power--are defined and the approach that was used to satisfy these requirements is presented. Currently the middeck experiment is being used as a test bed for the development of various space fluid system Author components.

N87-22001\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

#### SPACE STATION ELECTRIC POWER SYSTEM **REQUIREMENTS AND DESIGN**

Proposed for presentation at the 1987 15 p FRED TEREN 22nd Intersociety Energy Conversion Engineering Conference, Philadelphia, Pa., 10-14 Aug. 1987; sponsored by AIAA, ANS, ASME, SAE, IEEE, ACS and AIChE

(NASA-TM-89889; E-3577; NAS 1.15:89889; AIAA-87-9003)

Avail: NTIS HC A02/MF A01 CSCL 22B

An overview of the conceptual definition and design of the space station Electric Power System (EPS) is given. Responsibilities for the design and development of the EPS are defined. The EPS requirements are listed and discussed, including average and peak power requirements, contingency requirements, and fault tolerance. The most significant Phase B trade study results are summarized, and the design selections and rationale are given. Finally, the power management and distribution system architecture is presented.

National Aeronautics and Space Administration. N87-22003\*# Lewis Research Center, Cleveland, Ohio.

#### **COAXIAL TUBE ARRAY SPACE TRANSMISSION LINE** CHARACTERIZATION

COLLEEN A. SWITZER and DAVID J. BENTS 12 p Proposed for presentation at the 22nd Intersociety Energy Conversion Engineering Conference, Philadelphia, Pa., 10-14 Aug. 1987; sponsored by AIAA, ANS, ASME, SAE, IEEE, ACS and AIChÉ

(NASA-TM-89864; E-3531; NAS 1.15:89864) Avail: NTIS HC A02/MF A01 CSCL 09C

The coaxial tube array tether/transmission line used to connect an SP-100 nuclear power system to the space station was characterized over the range of reactor-to-platform separation distances of 1 to 10 km. Characterization was done with respect to array performance, physical dimensions and masses. Using a fixed design procedure, a family of designs was generated for the same power level (300 kWe), power loss (1.5 percent), and meteoroid survival probability (99.5 percent over 10 yr). To differentiate between vacuum insulated and gas insulated lines, two different maximum values of the E field were considered: 20 kV/cm (appropriate to vacuum insulation) and 50 kV/cm (compressed SF6). Core conductor, tube, bumper, standoff, spacer and bumper support dimensions, and masses were also calculated. The results of the characterization show mainly how transmission line size and mass scale with reactor-to-platform separation Author distance.

National Aeronautics and Space Administration. N87-22237\*# Lewis Research Center, Cleveland, Ohio.
A 2000-HOUR CYCLIC ENDURANCE TEST OF A

### LABORATORY MODEL MULTIPROPELLANT RESISTOJET

W. EARL MORREN and JAMES S. SOVEY 1987 24 p Presented at the 19th International Electric Propulsion Conference, Colorado Springs, Colo., 11-13 May 1987; sponsored by AIAA, DGLR and **JSASS** 

(NASA-TM-89854; E-3521; NAS 1.15:89854; AIAA-87-0993)

Avail: NTIS HC A02/MF A01 CSCL 13I

The technological readiness of a long-life multipropellant resistojet for space station auxiliary propulsion is demonstrated. A laboratory model resistojet made from grain-stabilized platinum served as a test bed to evaluate the design characteristics, fabrication methods, and operating strategies for an engineering model multipropellant resistojet developed under contract by the Rocketdyne Division of Rockwell International and Technion Incorporated. The laboratory model thruster was subjected to a

2000-hr, 2400-thermal-cycle endurance test using carbon dioxide propellant. Maximum thruster temperatures were approximately 1400 C. The post-test analyses of the laboratory model thruster included an investigation of component microstructures. Significant observations from the laboratory model thruster are discussed as they relate to the design of the engineering model thruster.

Author

National Aeronautics and Space Administration. N87-22949\*# Lewis Research Center, Cleveland, Ohio.

#### THERMODYNAMIC ANALYSIS AND SUBSCALE MODELING OF SPACE-BASED ORBIT TRANSFER VEHICLE CRYOGENIC PROPELLANT RESUPPLY

DAVID M. DEFELICE and JOHN C. AYDELOTT Jul. 1987 Prepared for presentation at the 23rd Joint Propulsion Conference, San Diego, Calif., 29 Jun. - 2 Jul. 1987; cosponsored by AIAA, SAE, ASME, and ASEE

(NASA-TM-89921; E-3617; NAS 1.15:89921; AIAA-87-1764)

The resupply of the cryogenic propellants is an enabling technology for spacebased orbit transfer vehicles. As part of the NASA Lewis ongoing efforts in microgravity fluid management, thermodynamic analysis and subscale modeling techniques were developed to support an on-orbit test bed for cryogenic fluid management technologies. Analytical results have shown that subscale experimental modeling of liquid resupply can be used to validate analytical models when the appropriate target temperature is selected to relate the model to its prototype system. Further analyses were used to develop a thermodynamic model of the tank chilldown process which is required prior to the no-vent fill operation. These efforts were incorporated into two FORTRAN programs which were used to present preliminary analyticl results.

National Aeronautics and Space Administration. N87-23821\*# Lewis Research Center, Cleveland, Ohio.

#### PRELIMINARY PERFORMANCE CHARACTERIZATIONS OF AN ENGINEERING MODEL MULTIPROPELLANT RESISTOJET FOR SPACE STATION APPLICATION

W. EARL MORREN, STUART S. HAY (Purdue Univ., West Lafavette, Ind.), THOMAS W. HAAG, and JAMES S. SOVEY Jul. 1987 24 p Presented at the 23rd Joint Propulsion Conference, San Diego, Calif., 29 Jun. - 2 Jul. 1987; cosponsored by AIAA, SAE, ASME, and ASEE

(NASA-TM-100113; E-3657; NAS 1.15:100113; AIAA-87-2120) Avail: NTIS HC A02/MF A01 CSCL 20H

Presented are the results of a program to describe the operational characteristics of an engineering model multipropellant resistojet for application as an auxiliary propulsion system for the space station. Performance was measured on hydrogen, helium, methane, water (steam), nitrogen, air, argon, and carbon dioxide. Thrust levels ranged form 109 to 355 mN, power levels ranged from 167 to 506 W, and specific impulse values ranged from 93 to 385 sec, depending on the propellant, chamber pressure, and heater current level selected. Detailed thermal maps of the heater and heat exchanger were also obtained for operation with carbon **Author** dioxide.

N87-24536\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

#### RESISTOJET PLUME AND INDUCED ENVIRONMENT ANALYSIS M.S. Thesis - Case Western Reserve Univ.

DAVID J. HOFFMAN May 1987 60 p

(NASA-TM-88957; E-3410; NAS 1.15:88957) Avail: NTIS HC A04/MF A01 CSCL 21H

The source flow method developed by G.A. Simons for calculating the far field plume density produced by high thrust rocket nozzles is modified and applied to low thrust resistojet nozzles with Reynolds numbers on the order of 4000 to 7000. Simons' original method and the modified analysis are compared to mass flux measurements taken by Chirivella in a JPL vacuum tank facility. Results of the comparison show the modified analysis presented more accurately predicts the mass flux at large angles

from the nozzle centerline than Simons' original method. The modified Simons analysis is then used to calculate the plume structure and two contamination parameters, number column density and back flow, for five nozzle geometries representative of Space Station resistojets.

N87-24641\*# Beech Aircraft Corp., Boulder, Colo.
SPACE STATION EXPERIMENT DEFINITION: LONG-TERM **CRYOGENIC FLUID STORAGE Final Report** 

R. L. JETLEY and R. D. SCARLOTTI Washington NASA Jun. 1987 257 p

(Contract NAS3-24661)

(NASA-CR-4072; E-3463; NAS 1.26:4072; BAC-ER-18056-8) Avail: NTIS HC A12/MF A01 CSCL 20D

The conceptual design of a space station Technology Development Mission (TDM) experiment to demonstrate and evaluate cryogenic fluid storage and transfer technologies is presented. The experiment will be deployed on the initial operational capability (IOC) space station for a four-year duration. It is modular in design, consisting of three phases to test the following technologies: passive thermal technologies (phase 1), fluid transfer (phase 2), and active refrigeration (phase 3). Use of existing hardware was a primary consideration throughout the design effort. A conceptual design of the experiment was completed, including configuration sketches, system schematics, specifications, and space station resources and interface requirements. These requirements were entered into the NASA Space Station Mission Data Base. A program plan was developed defining a twelve-year development and flight plan. Program cost estimates are given.

N87-25422\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SPACE STATION PROPULSION SYSTEM TECHNOLOGY ROBERT E. JONES, PHILLIP R. MENG, STEVEN J. SCHNEIDER, JAMES S. SOVEY, and ROBERT R. TACINA 1987 18 p Proposed for presentation at the 38th International Astronautical Federation Congress, Brighton, England, 10-17 Oct. 1987 (NASA-TM-100108; E-3648; NAS 1.15:100108) Avail: NTIS HC A02/MF A01 CSCL 21H

Two propulsion systems have been selected for the space station: O/H rockets for high thrust applications and the multipropellant resistojets for low thrust needs. These thruster systems integrate very well with the fluid systems on the station. Both thrusters will utilize waste fluids as their source of propellant. The O/H rocket will be fueled by electrolyzed water and the resistojets will use stored waste gases from the environmental control system and the various laboratories. This paper presents the results of experimental efforts with O/H and resistojet thrusters to determine their performance and life capability.

N87-25888\*# New Mexico Univ., Albuquerque. Dept. of Chemical and Nuclear Engineering.

#### AN ANALYSIS OF BIPROPELLANT NEUTRALIZATION FOR SPACECRAFT REFUELING OPERATIONS

DAVID KAUFFMAN In NASA. Lyndon B. Johnson Space Center, National Aeronautics and Space Administration (NASA)/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1986, Volume 2 14 p Avail: NTIS HC A13/MF A01 CSCL 21H

Refueling of satellites on orbit with storable propellants will involve venting part or all of the pressurant gas from the propellant tanks. This gas will be saturated with propellant vapor, and it may also have significant amounts of entrained fine droplets of propellant. The two most commonly used bipropellants, monomethyl hydrazine (MMH) and nitrogen tetroxide (N2O4), are highly reactive and toxic. Various possible ways of neutralizing the vented propellants are examined. The amount of propellant vented in a typical refueling operation is shown to be in the range of 0.2 to 5% of the tank capacity. Four potential neutralization schemes are examined chemical decomposition, chemical reaction, condensation and adsorption. Chemical decomposition to essentially inert materials is thermodynamically feasible for both

MMH and N2O4. It would be the simplest and easiest neutralization method to implement. Chemical decomposition would require more complex control. Condensation would require a refrigeration system and a very efficent phase separator. Adsorption is likely to be much heavier. A preliminary assessment of the four neutralization shemes is presented, along with suggested research and development plans.

N87-26058# Erno Raumfahrttechnik G.m.b.H., Bremen (West Germany).

A STUDY OF FLUID TRANSFER MANAGEMENT IN SPACE **Executive Summary Report** 

J. KOWALEK, J. POÉLSTRA, G. BERGER, and E. ROMERO Paris, France ESA Feb. 1986 76 p (Contract ESTEC-6013/84-NL-PB(SC))

(FTMS-RPT-006; ESA-CR(P)-2348; ETN-87-99995) Avail: NTIS HC A05/MF A01

In-orbit refueling was studied. Direct fluid transfer is feasible to refuel storable propulsion fluids in orbit. Automated refueling takes place in conjunction with a berthing port. Fluid interfaces using hose connections are also possible for dedicated applications. The propellant masses to be transferred range from 100 to 1000 kg. The cost effectiveness of a refueling system increases significantly if the tank capacity is designed for multiple refueling operation. A refueling system has an autonomous control capability for the refueling procedure with supervision possibility by the supplier spacecraft or by remote control. For refueling, the receiver propulsion system is switched off. Nevertheless, the receiver propulsion system has to ensure functional access for control of components and for monitoring of data which are required for the execution of the refueling procedure. Therefore, a receiver propulsion system contains elements needed for refueling only.

ESA

N87-26062\*# General Electric Co., Philadelphia, Pa. Re-Entry Systems Operations.

SYSTEM TECHNOLOGY ANALYSIS OF AEROASSISTED ORBITAL TRANSFER VEHICLES. MODERATE LIFT/DRAG (0.75-1.5). VOLUME 1A, PART 1: EXECUTIVE SUMMARY. **PHASE 1 Final Report** 

Aug. 1985 30 p (Contract NAS8-35096) (NASA-CR-179139; NAS 1.26:179139;

REPT-85SDS2184-VOL-1A-PT-1) Avail: NTIS HC A03/MF A01 CSCL 22A

Activities and significant results of Phase 1 of a study to access aeroassisted orbit transfer vehicle (AOTV) system technology are summarized. Broad concept evaluations were performed and the technology requirements and sensitivities for ground based AOTV's over a range of vehicle hypersonic lift/drag (L/D) from 0.75 to 1.5 were systematically identified and assessed. The four major task areas included systems analysis, system/subsystem trades, technology payoff assessment and plan, and cost analysis. Findings indicate that substantial performance improvements and hence cost benefit can be obtained by developing enhanced technologies such as: (1) low thrust advanced expander LOX-hydrogen engines with specific impulse of 480 to 490 sec; (2) reducing the external thermal protection system weight and increasing the maximum allowable bond/structure temperature; and (3) reducing the structural shell weight by improving the quality of the design allowable data, or use of advanced structural materials. Results also show that use of mid L/D AOTV's provide significant aerodynamic plane change capability and control authority over trajectory dispersions and off-nominal atmospheres.

N87-26081\*# General Dynamics Corp., San Diego, Calif. Space Systems Div.

DESIGN AND DEMONSTRATE THE PERFORMANCE OF CRYOGENIC COMPONENTS REPRESENTATIVE OF SPACE **VEHICLES: START BASKET LIQUID ACQUISITION DEVICE** PERFORMANCE ANALYSIS

Feb. 1987 50 p

(Contract NAS8-31778)

(NASA-CR-179138; NAS 1.26:179138; GDSS-CRAD-87-004)

Avail: NTIS HC A03/MF A01 CSCL 22B

The objective was to design, fabricate and test an integrated cryogenic test article incorporating both fluid and thermal propellant management subsystems. A 2.2 m (87 in) diameter aluminum test tank was outfitted with multilayer insulation, helium purge system, low-conductive tank supports, thermodynamic vent system, liquid acquisition device and immersed outflow pump. Tests and analysis performed on the start basket liquid acquisition device and studies of the liquid retention characteristics of fine mesh screens are discussed.

N87-26116\*# Aerojet Strategic Propulsion Co., Sacramento, Calif.

## EVALUATION OF CARBON-CARBON FOR SPACE ENGINE

J. P. SUHOZA, J. L. KIRKHART, J. O. BIRD, G. W. CAWOOD, and R. L. BICKFORD (Aerojet TechSystems Co., Sacramento, Calif.) /n Johns Hopkins Univ., The 1986 JANNAF Propulsion Meeting, Volume 1 p 379-385 Aug. 1986 (Contract NAS8-35971)

Avail: NTIS HC A25/MF A01 CSCL 11D

An investigation is underway to determine the suitability of carbon-carbon composite materials for lightweight nozzle extensions on the Orbit Transfer Vehicle (OTV). The best combinations of fiber precursor, matrix material, and oxidation protection coatings are being evaluated in a series of hot-fire tests in an O sub 2/H sub 2 rocket nozzle environment. Evaluation criteria include life expectancy (recession), strength to weight, producibility, maturity, and cost. A data base of carbon-carbon performance in the OTV nozzle environment will be established which may be used in designing a full-scale OTV nozzle extension.

## N87-26129\*# Martin Marietta Aerospace, Denver, Colo. PROPULSION RECOMMENDATIONS FOR SPACE STATION FREE FLYING PLATFORMS

L. R. REDD and L. J. ROSE In Johns Hopkins Univ., The 1986 JANNAF Propulsion Meeting, Volume 1 p 515-523 Aug. 1986 (Contract NAS3-23893)

Avail: NTIS HC A25/MF A01 CSCL 21H

Propulsion system candidates have been defined for Space Station free flying platforms for the purpose of comparison and to understand the impact of the various mission requirements on the candidate designs. Recommendations for propulsion for each of the various platforms are given.

N87-26130# Rockwell International Corp., Canoga Park, Calif. Rocketdyne Div.

HYDROGEN/OXYGEN ECONOMY FOR THE SPACE STATION JOSEPH E. GRAETCH In Johns Hopkins Univ., The 1986 JANNAF Propulsion Meeting, Volume 1 p 525-532 Aug. 1986 Avail: NTIS HC A25/MF A01 CSCL 22B

The concept of a hydrogen/oxygen economy, which involves the functional integration of the major water/hydrogen/oxygen producers and consumers aboard the Space Station is discussed. It is shown that all or most of the projected propellant needs of the Station can be met with propellants derived from the hydrogen/oxygen economy, while meeting all other water and oxygen needs of the Station. An alternative is suggested to the baseline Station air revitalization program in which the Sabatier process is used in place of the Bosch process. It is shown that the Sabatier process has about the same capability to meet the propulsion needs, while offering a number of design and operational options that may impact both the environmental control and life support system and the propulsion system.

N87-26131\*# National Aeronautics and Space Administration.
Marshall Space Flight Center, Huntsville, Ala.
SPACE STATION PROPULSION TEST BED: A COMPLETE

G. L. BRILEY, A. M. NORMAN (Rockwell International Corp.,

Canoga Park, Calif.), L. JONES, and H. CAMPBELL In Johns Hopkins Univ., The 1986 JANNAF Propulsion Meeting, Volume 1 p 533-538 Aug. 1986 Previously announced in IAA as A86-42615

Avail: NTIS HC A25/MF A01 CSCL 14B

A test bed was fabricated to demonstrate hydrogen/oxygen propulsion technology readiness for the Initial Operating Capabilities (IOC) space station application and for use as a means to test evolving technology for the growth station. The test bed, its function, and plans for future testing are discussed.

Author

N87-26132\*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

## A 25-LBF GASEOUS OXYGEN/GASEOUS HYDROGEN THRUSTER FOR SPACE STATION APPLICATION

B. J. HECKERT, T. I. YU (Rockwell International Corp., Canoga Park, Calif.), S. L. ALLUMS, and E. A. CARRASQUILLO *In* Johns Hopkins Univ., The 1986 JANNAF Propulsion Meeting, Volume 1 p 539-546 Aug. 1986

Avail: NTIS HC A25/MF A01 CSCL 21H

A prototype 25 lb sub f gaseous oxygen/gaseous hydrogen thruster for Space Station propulsion application was designed and fabricated by Rocketdyne and endurance tested at the NASA/Marshall space Flight Center. The thruster incorporates a regeneratively cooled thrust chamber with a nozzle exit area ratio of 30, a 12-element coaxial injector, a spark igniter, and close-coupled propellant valves. Test results indicate that all major technology issues for long-life gaseous oxygen/gaseous hydrogen thrusters for Space Station application have been resolved.

Author

N87-26133\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

## PROVEN, LONG-LIFE HYDROGEN/OXYGEN THRUST CHAMBERS FOR SPACE STATION PROPULSION

G. PAUL RICHTER and HAROLD G. PRICE In Johns Hopkins Univ., The 1986 JANNAF Propulsion Meeting, Volume 1 p 547-564 Aug. 1986 Previously announced as N86-32522 Avail: NTIS HC A25/MF A01 CSCL 21H

A 25 lb sub f hydrogen/oxygen thruster has been developed and proven as a viable candidate to meet the needs of the Space Station Program. Likewise, a 50 lb sub f hydrogen/oxygen thrust chamber has been developed and has demonstrated reliable, long-life expectancy at anticipated Space Station operating conditions. Both these thrust chambers were based on design criteria developed in previous thruster programs. Extensive thermal analysis and models were used to design the thrusters to achieve total impulse goals of 2 million lb sub f sec. Test data from each thruster are compared to the analytical predictions for the performance and heat transfer characteristics. Also, the results of thrust chamber life verification tests are presented.

N87-26135\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

## WATER-PROPELLANT RESISTOJETS FOR MAN-TENDED PLATFORMS

ALLEN J. LOUVIERE (Space Industries, Inc., Webster, Tex.), ROBERT E. JONES, W. EARL MORREN, and JAMES S. SOVEY 1987 17 p Proposed for presentation at the 38th International Astronautical Federation Congress, Brighton, England, 10-17 Oct. 1987

(NASA-TM-100110; E-3649; NAS 1.15:100110; IAF-87-259) Avail: NTIS HC A02/MF A01 CSCL 21H

The selection of a propulsion system for a man-tended platform has been influenced by the planned use of resistojets for drag make-up on the manned space station. For that application a resistojet has been designed that is capable of operation with a wide variety of propellants, including water. The reasons for the selection of water as the propellant and the performance of water as a propellant are discussed. The man-tended platform and its mission requirements are described.

#### N87-28405# Brookhaven National Lab., Upton, N. Y. NUCLEAR PROPULSION SYSTEMS FOR ORBIT TRANSFER BASED ON THE PARTICLE BED REACTOR

J. R. POWELL, H. LUDEWIG, F. L. HORN, K. ARAJ, R. BENENATI, O. LAZARETH, G. SLOVIK, M. SOLON, W. TAPPE, J. BELISLE (Grumman Aerospace Corp., Bethpage, N.Y.) et al. 1987 Presented at the 4th Symposium on Space Nuclear Power Systems, Albuquerque, N. Mex., 12 Jan. 1987 Prepared in cooperation with Babcock and Wilcox Co., Lynchburg, Va. and Garrett Engine Co., Phoenix, Ariz.

(Contract DE-AC02-76CH-00016)

(DE87-010060; BNL-39695; CONF-870102-23) Avail: NTIS HC A03/MF A01

The technology of nuclear direct propulsion orbit transfer systems based on the Particle Bed Reactor (PBR) is described. A 200 megawatt illustrative design is presented for LEO to GEO and other high V missions. The PBR-NOTV can be used in a one-way mode with the shuttle or an expendable launch vehicle, e.g., the Titan 34D7, or as a two-way reusable space tug. In the one-way mode, payload capacity is almost three times greater than that of chemical OTV's. PBR technology status is described and development needs outlined.

N87-29930\*# International Fuel Cells Corp., South Windsor. Conn.

#### ADVANCED FUEL CELL CONCEPTS FOR FUTURE NASA **MISSIONS Abstract Only**

J. K. STEDMAN In NASA-Lewis Research Center, Space Electrochemical Research and Technology (SERT) p 125

Avail: NTIS HC A16/MF A01 CSCL 10C

Studies of primary fuel cells for advanced all electric shuttle type vehicles show an all fuel cell power system with peak power capability of 100's of kW to be potentially lighter and have lower life cycle costs than a hybrid system using advanced H2O2 APU's for peak power and fuel cells for low power on orbit. Fuel cell specific weights of 1 to 3 lb/kW, a factor of 10 improvement over the orbiter power plant, are projected for the early 1990's. For satellite applications, a study to identify high performance regenerative hydrogen oxygen fuel cell concepts for geosynchronous orbit was completed. Emphasis was placed on concepts with the potential for high energy density (Wh/lb) and passive means for water and heat management to maximize system reliability. Both alkaline electrolyte and polymer membrane fuel cells were considered.

#### 10

#### MECHANISMS, AUTOMATION, AND ARTIFICIAL INTELLIGENCE

Includes descriptions of simulations, models, analytical techniques, and requirements for remote, automated and robotic mechanical systems.

#### A87-31493

#### USE OF HEADS-UP DISPLAYS, SPEECH RECOGNITION, AND SPEECH SYNTHESIS IN CONTROLLING A REMOTELY PILOTED SPACE VEHICLE

CRAIG S. HARTLEY and ROBERT PULLIAM (Martin Marietta Space Operations Simulator Laboratory, Denver, CO) IN: Digital Avionics Systems Conference, 7th, Fort Worth, TX, Oct. 13-16, 1986, Proceedings . New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 338-345.

Displays and controls must be optimized for the future operation of remotely piloted space vehicles (RPSVs). Experiments at the Martin Marietta Space Operations Simulator Laboratory in Denver are reported in which heads-up displays and voice input/output were implemented on an experimental pilot console. These displays and controls were developed interactively during the simulation of

RPSV and Space Station operations. Demonstrated and evaluated were 7 heads-up reticle displays, 2 heads-up data displays, selection of displays by voice command, use of voice command to call for range and rate data, and the voice annunciation of alarms. Development continues and will explore application of expert systems to RPSV control.

#### A87-32449

#### CONTROL OF A FLEXIBLE SPACE MANIPULATOR

TOSHIO FUKUDA (Tokyo University of Science, Japan) and IN: International Symposium on Space ATSUSHI ARAKAWA Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 1285-1290. refs

A flexible control method based on the dynamic characteristics of flexible manipulator arms is proposed. The modeling of the dvnamic characteristics of flexible arms with two degrees-of-freedom is described; the modeling takes consideration the coupling between the arms due to vibrations. The ability of the basic characteristics of the flexible robotic arms to control the arms is evaluated experimentally, and it is determined that the control method is effective.

#### A87-32633

A SIMULATION CAPABILITY FOR FUTURE SPACE FLIGHT RICHARD A. SKIDMORE and ROBERT PULLIAM (Martin Marietta Corp., Denver, CO) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 13-16, 1986. 8 p. (SAE PAPER 861784)

The limited number of laboratories which can simulate operations in space provide a critical engineering resource. Among these the Martin Marietta Space Operations Simulator Laboratory in Denver provides resources for real-time piloted flight and other human/machine simulations. Its facilities include degree-of-freedom (DOF), man-rated carriage with a 3 DOF target gimbal, which is computer driven to simulate flight in space. This system can simulate astronaut freeflight, or the relative motion of any two bodies in space. Other resouces include a manipulator arm, a neutral bouyancy tank, a Shuttle Orbiter aft flight deck mockup, and a large screenflight simulator. Recently developed is computer generated imagery for low cost space simulation, with 3-body motion, flexible body dynamics, and simulated handling of payloads at the Space Station. Advanced pilot consoles are used to control simulations and for control-display experiments. New resources are being developed.

A87-32745\* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

LASER DOCKING SYSTEM FLIGHT EXPERIMENT

HARRY O. ERWIN (NASA, Johnson Space Center, Houston, TX) IN: Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 . San Diego, CA, Univelt, Inc., 1986, p. 335-342. (AAS PAPER 86-043)

Experiments necessary in the development of the Laser Docking System (LDS) are described. The LDS would be mounted in the Orbiter payload bay, along with a grid connected by fiber optic link to a computer in the cabin. The tests would be performed to aid in the design of an operational sensor which could track a passive target accurately enough to permit soft docking. Additional data would be gained regarding the LDS performance in space, the effects of Orbiter RCS plume impingement on the target, and refinements needed for the flight hardware. A working model which includes an IR laser steered by galvanometer-driven motors for bouncing beams off retroreflectors mounted on targets is described, together with a 300 ft long indoor test facility. Tests on Orbiter flights would first be in a wholly automatic mode and then in a man-in-the-loop mode. M.S.K.

National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. SYSTEM ARCHITECTURE FOR THE TELEROBOTIC WORK SYSTEM

### 10 MECHANISMS, AUTOMATION, AND ARTIFICIAL INTELLIGENCE

LYLE M. JENKINS (NASA, Johnson Space Center, Houston, TX) IN: Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 . San Diego, CA, Univelt, Inc., 1986, p. 343-348. (AAS PAPER 86-044)

The functional and performance requirements and design concepts for a telerobotic work system (TWS) being considered as an adjunct to the Shuttle Remote Manipulator System and other applications are described. The multiple-armed free-flyer would be controlled by an operator in the Orbiter cabin and would perform remote sensing and manipulative tasks that EVA crew otherwise carry out. The TWS could also perform hazardous tasks, construction operations, and be an asset to the Space Station. Alternative system architectures are described, including the man-machine interface, the types of manipulators and their stowage, and the controls and backup systems. Potential terrestrial applications of the TWS concept, augmented with Al capabilities, are discussed.

National Aeronautics and Space Administration, A87-33867\*# Washington, D.C.

#### OVERVIEW OF THE NASA AUTOMATION AND ROBOTICS RESEARCH PROGRAM

LEE HOLCOMB and RON LARSEN (NASA, Washington, DC) IN: Association for Unmanned Vehicle Systems; Annual Meeting, 12th, Anaheim, CA, July 15-17, 1985, Preliminary Proceedings . Washington, DC, Association for Unmanned Vehicle Systems, 1985, 20 p. refs

NASA studies over the last eight years have identified five opportunities for the application of automation and robotics technology: (1) satellite servicing; (2) system monitoring, control, sequencing and diagnosis; (3) space manufacturing; (4) space structure assembly; and (5) planetary rovers. The development of these opportunities entails two technology R&D thrusts: telerobotics and system autonomy; both encompass such concerns as operator interface, task planning and reasoning, control execution, sensing, and systems integration.

National Aeronautics and Space Administration. A87-37300\*# Lyndon B. Johnson Space Center, Houston, Tex.

#### MANNED SPACECRAFT AUTOMATION AND ROBOTICS

JON D. ERICKSON (NASA, Johnson Space Center, Houston, TX) IEEE, Proceedings (ISSN 0018-9219), vol. 75, March 1987, p. 417-426. refs

The Space Station holds promise of being a showcase user and driver of advanced automation and robotics technology. The author addresses the advances in automation and robotics from the Space Shuttle - with its high-reliability redundancy management and fault tolerance design and its remote manipulator system - to the projected knowledge-based systems for monitoring, control, fault diagnosis, planning, and scheduling, and the telerobotic systems of the future Space Station.

#### A87-40844# **ROBOTS ON THE SPACE STATION**

Aerospace America (ISSN 0740-722X), vol. ERIC J. LERNER 25, June 1987, p. 42-45.

Teleoperated robotic devices, or 'telerobots', such as those in use at nuclear processing facilities, are undergoing Space Station applicability evaluations which give attention to such questions as the degree of autonomy feasible or desirable for such devices and their most advantageous location. The mechanical elements of the telerobot are noted to require the most intensive modification for operations in a microgravity environment, due to the presence of backlash in many of its operations. A torque feedback loop has been developed which directly controls the force borne by arm joints.

#### A87-41152#

#### AN INTEGRATED APPROACH TO SPACECRAFT DESIGN FOR ROBOTIC SERVICING

J. L. NEVINS, D. E. WHITNEY, and R. W. METZINGER (Charles AIAA, NASA, Stark Draper Laboratory, Inc., Cambridge, MA)

and USAF, Symposium on Automation, Robotics and Advanced Computing for the National Space Program, 2nd, Arlington, VA, Mar. 9-11, 1987. 9 p. refs (AIAA PAPER 87-1672)

A highly integrated approach to spacecraft design (the strategic approach to product design) is developed which involves all aspects of the manufacturing process as well as product design and its eventual use. This approach is important in the context of the technology (EVA or telerobotics) currently available to support on-orbit assembly or servicing. The forces driving this approach for industry include the complexity of new products and the disappearance of manual assembly as an option; for spacecraft, they include the need for exceptionally long product life and for spacecraft designs that can be maintained rather than replaced.

#### A87-41153# THE CANADIAN ROBOTIC SYSTEM FOR THE SPACE **STATION**

DOUGLAS CASWELL (National Research Council of Canada, Ottawa) and DEV GOSSAIN (Spar Aerospace, Ltd., Remote Manipulator Systems Div., Toronto, Canada) AIAA, NASA, and USAF, Symposium on Automation, Robotics and Advanced Computing for the National Space Program, 2nd, Arlington, VA. Mar. 9-11, 1987. 6 p. (AIAA PAPER 87-1677)

The general concept of the Mobile Servicing Center and the Special Purpose Dextrous Manipulator (SPDM), both of which are parts of the Space Station Mobile Servicing System, is described. The role of the SPDM in the assembly and maintenance of the Station and the servicing of payloads and other equipment is outlined. Planning activities for technology diffusion and exploitation of the terrestrial economy are also addressed.

#### A87-45797\* Catholic Univ. of America, Washington, D.C. CONTROL OF ROBOT MANIPULATOR COMPLIANCE

CHARLES C. NGUYEN, FARHAD J. POORAN (Catholic University of America, Washington, DC), and TIMOTHY PREMACK (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: Recent trends in robotics: Modeling, control and education. Amsterdam, North-Holland, 1986, p. 237-242. refs (Contract NAG5-780)

Robotic assembly operations such as mating and fastening of parts are more successful if the robot manipulator compliance can be controlled so that various coordinates are free to comply with external constraints. This paper presents the design of a hybrid controller to provide active compliance six-degree-of-freedom robot built at NASA/GSFC using force and position feedback. Simulation results of a 2 degree-of-freedom model is presented and discussed.

#### A87-46704# ROBOTIC TELEPRESENCE

GEORGE C. MOHR (USAF, Harry G. Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: 1987 Annual Reliability and Maintainability Symposium, Philadelphia, PA, Jan. 27-29, 1987, Proceedings . New York, Institute of Electrical and Electronics Engineers, Inc., 1987, p. 25-30. refs

The concept of robotic telepresence, the linking of human hands and eyes with a robot's hands and eyes to permit viewing and manipulating objects from a remote location, is discussed. A 'master-slave' relationship between the human controller and robot is based on closed loop visual, tactile, and force sensing and display, coupled with head, eye, arm, hand, and finger position control of the robotic system. Technological areas requiring increased emphasis include hand-finger position sensing, tactile-force displays, and time-delay control compensation. The concept has application to the performance of maintenance, repair, and construction tasks in a hostile environment to enhance military capability, and for manned operations in both orbital and deep space environments.

A87-48156

CONTROL OF AN AUTONOMOUS SPACECRAFT RENDEZVOUS AND DOCKING MANEUVER BY MEANS OF IMAGE PROCESSING [KONTROLLE EINES AUTONOM ABLAUFENDEN ANNAEHERUNGS- UND KOPPLUNGSMANOEVERS IN DER RAUMFAHRT DURCH **BILDVERARBEITUNG**1

R. HEHNEN (AEG AG, Wedel, West Germany) 1986 II; DGLR, Annual Meeting, Munich, West Germany, Oct. 8-10, 1986, Reports . Bonn, Deutsche Gesellschaft fuer Luft- und Raumfahrt, 1986, p. 481-503. In German. (DGLR PAPER 86-122)

The design concept and predicted performance of a spacecraft rendezvous and docking (RVD) control are discussed and illustrated with drawings and diagrams. The RVD system is based on a video tracking system for ship maneuvers at offshore oil-drilling platforms. The operation of the ship system is described; the demands imposed by the RVD mission are outlined; the hardware design (a CCD video camera with 512 x 512-pixel format and field of view switchable among 500, 133, and 33 mrad; an illuminator; processing and correlation electronics; and reflectors) is presented; and the fundamental principles of the pattern recognition techniques employed are summarized.

A87-51979#

DEVELOPMENT OF A SMALL-SIZED SPACE MANIPULATOR

YOSHITUGU TODA, KAZUO MACHIDA, TOSHIAKI IWATA, MASAO INOUE, KATSUHIKO YAMADA et al. Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 35, no. 401, 1987, p. 294-302. In Japanese, with abstract in English. refs

Future space stations and space factories which require many types of manipulators or robots for assembling and servicing in space, especially demand small-sized manipulators for dexterous tasks. A 1-meter class articulated manipulator with space environment durability and light weight has been developed. This paper presents the system design of the manipulator and development efforts of its components. The design of actuators and a hand, a tribological investigation of mechanical elements in the vacuum environment, the multiprocessor control system, and the dynamic control algorithm of the arm, are described. Author

A87-53059#

#### SPACE STATION AUTONOMY - WHAT ARE THE CHALLENGES? HOW CAN THEY BE MET?

RONALD A. HAMMOND (Boeing Computer Services Advanced Technology Center, Seattle, WA) IN: AAAIC '86 - Aerospace Applications of Artificial Intelligence; Proceedings of the Second Annual Conference, Dayton, OH, Oct. 14-17, 1986. Volume 1 Dayton, OH, AAAIC Conference Secretariat, 1986, p. 2-6. refs

Autonomous systems encompassing knowledge-based systems and robotics for various tasks will be required to aid both the on-orbit and ground support operations of the NASA Space Station. These autonomous systems will reduce human exposure to hazardous environments as well as training requirements and involvement in repetitive tasks. Advanced automation and robotic systems will require advanced operator/system interfaces. Currently envisioned are knowledge-based systems for on-orbit and for ground operations, and robotics for both on-orbit experimental and manufacturing processes, as well as routine orbital 'housekeeping' operations.

A87-53991

#### THE ASTRONAUT AND THE ROBOT - SHORT- AND LONG-TERM SCENARIOS FOR SPACE TECHNOLOGY

ANDRE LEBEAU (Conservatoire National des'Arts et Metiers, Paris, France) (Futuribles, Sept. 1986) Space Policy (ISSN 0265-9646). vol. 3, Aug. 1987, p. 207-220.

The prospects for space technology over the next decades are assessed, contrasting the slowing growth of 'conventional' space activities (communications, remote sensing, or collection of scientific data) with the potential of new-generation manned systems (the Space Station, Mir/Salyut, and Hermes). The

short-term military (ABM/SDI) and civilian (materials processing) applications of such systems are considered, but the need for a long-term global strategy aimed at freeing technology from the limitations of the biosphere is stressed. It is suggested that advances in robotics could reduce the number of human interventions required to meet these goals. Increased privatization of mature technologies and intense efforts to mobilize public opinion are recommended. Also included are critical examinations of (1) the current technological and competitive status of U.S. and European launch vehicles and (2) the arguments used by some space scientists against the emphasis on manned programs.

N87-20370# National Aeronautical Establishment, Ottawa (Ontario).

#### USE OF A VIDEO-PHOTOGRAMMETRY SYSTEM FOR THE MEASUREMENT OF THE DYNAMIC RESPONSE OF THE SHUTTLE REMOTE MANIPULATOR ARM

G. L. BASSO and R. B. KULCHYSKI In AGARD Mechanical Qualification of Large Flexible Spacecraft Structures 12 p

Avail: NTIS HC A12/MF A01

A video-photogrammetry system was used to obtain the dynamic response of the Canadian developed, space transportation system remote manipulator arm from video tape recordings of two space based test events - specifically, an auto-trajectory and a backup mode test sequence. The application of this system to this task represented a non-generic use in that no pre-launch preparations were made for implementing this technique. The procedures used to extract the response information from the video tapes are outlined. The stated resolution of the video-photogrammetry system is 1 part in 5000 (1 sigma) - typically, 0.03mm for a 12.5mm image plane size. Within this capability, the amplitude of the response for the auto-trajectory sequence was obtained with an estimated resolution of 1mm with a camera-to-object spacing of 2.18m; and for the backup mode, 3mm at a spacing of 13.78m. In both instances, dynamic parameters such as frequency and damping were readily derived from the response measurements.

#### N87-20774# Oak Ridge National Lab., Tenn. THE OAK RIDGE NATIONAL LABORATORY'S ROBOTICS AND INTELLIGENT SYSTEMS PROGRAM

S. A. MEACHAM 23 Jan. 1987 8 p Presented at the Roane-Anderson Economic Council Meeting, Oak Ridge, Tenn., 23 Jan. 1987

(Contract DE-AC05-84OR-21400)

(DE87-004627; CONF-870148-1) Avail: NTIS HC A02/MF A01
The goals of the newly formed Robotics and Intelligent Systems Program are discussed. The application of the remote systems technology developed by the Consolidated Fuel Reprocessing Program for the Department of Energy is presented. The activities (satellite refueling and space station truss assembly) with the National Aeronautics and Space Administration are presented in a videotape format with narration by the presenter. The goals of technology transfer to the private sector and the potential positive impact on the community conclude the oral presentation.

#### N87-22231# Oak Ridge National Lab., Tenn. APPLICATION OF A TRACTION-DRIVE 7-DEGREES-OF-FREEDOM TELEROBOT TO SPACE MANIPULATION

D. P. KUBAN and W. R. HAMEL 1987 18 p Presented at the 10th American Astronautical Society Annual Guidance and Control Conference, Keystone, Colo., 31 Jan. 1987 (Contract DE-AC05-84OR-21400)

(DE87-004616; CONF-870147-1) Avail: NTIS HC A02/MF A01

The Space Station Program marks a new era in space exploration and habitation. To meet the challenges of this new era, more extensive use of remote manipulation and robotics is expected. This paper describes a new space telerobot concept which addresses both teleoperations and robotics needs of future space programs, while merging the desirable characteristics of

both technologies. This new concept is based on knowledge and experience gained from manipulator systems developed to meet the needs of remote nuclear applications. It merges desirable characteristics of teleoperation and robotic technologies. Presented here are design goals for the telerobot, a description of the mechanical and control abilities, and applications for Earth and space. The concept incorporates mechanical traction drives, redundant kinematics, and modular arm subelements to provide a backlash-free manipulator capable of obstacle avoidance. Further development of this telerobot is in progress at the Oak Ridge National Laboratory.

N87-22233# Oak Ridge National Lab., Tenn. TRACTION-DRIVE TELEROBOT FOR SPACE MANIPULATION J. N. HERNDON, W. R. HAMEL, and D. P. KUBAN 20 Feb. 1987 14 p Presented at the IEEE International Conference on Robotics and Automation, Raleigh, N.C., 30 Mar. 1987 (Contract DE-AC05-84OR-21400)

(DE87-005326; CONF-870354-2) Avail: NTIS HC A02/MF A01 The National Aeronautics and Space Administration (NASA) Space Station Program marks the beginning of a new era in space utilization and habitation. Extensive use of remote manipulation and robotics to reduce astronaut extra-vehicular activity is expected. Emphasis on teleoperator technology in early space station phases, followed by growth of autonomous robotics capabilities, is planned. A new telerobot concept has been developed at Oak Ridge National Laboratory (ORNL), under NASA Langley Research Center sponsorship, to address the technical needs of both teleoperations and robotics for these future NASA programs. The concept is based on traction drives, redundant kinematics, modular construction, and a state-of-the-art distributed, hierarchical control

#### N87-22242\*# Oak Ridge National Lab., Tenn. TELEROBOTIC TECHNOLOGY FOR NUCLEAR AND SPACE APPLICATIONS

J. N. HERNDON and W. R. HAMEL Mar. 1987 13 p Presented at the AIAA, NASA and U.S. Air Force Symposium, Arlington, Va., 9 Mar. 1987 Sponsored by NASA (Contract DE-AC05-84OR-21400)

(NASA-CR-180923; NAS 1.26:180923; DE87-007012;

CONF-870395-1) Avail: NTIS HC A02/MF A01 CSCL 13I

Telerobotic development efforts at Oak Ridge National Laboratory are extensive and relatively diverse. Current efforts include development of a prototype space telerobot system for the NASA Langley Research Center and development and large-scale demonstration of nuclear fuel cycle teleoperators in the Consolidated Fuel Reprocessing Program. This paper presents an overview of the efforts in these major programs.

Royal Netherlands Aircraft Factories Fokker, N87-24486# Amsterdam. Attitude Control Dept.

END EFFECTOR DEVELOPMENT STUDY. VOLUME 2: SERVICE END EFFECTOR SUBSYSTEM SPECIFICATION (SEESSPEC) Final Report

ÀAD VANSWIETEN Paris, France ESA 15 Jul. 1986 42 p (Contract ESA-1682/84-NL-AN)

(FOK-TR-R-86-091-VOL-2; ESÁ-CR(P)-2346-VOL-2;

ETN-87-99887) Avail: NTIS HC A03/MF A01

An update of the service end effector subsystem specification, based on the experiences obtained during the design iteration of the second phase, is presented.

Royal Netherlands Aircraft Factories Fokker, N87-25336# Amsterdam. Attitude Control Dept.

END EFFECTOR DEVELOPMENT STUDY, VOLUME 1 Final

AAD VANSWIETEN Paris, France ESA 15 Jul. 1986 162 p

(Contract ESA-1682/84-NL-AN) (FOK-TR-R-86-091-VOL-1; ESA-CR(P)-2346-VOL-1:

ETN-87-99886) Avail: NTIS HC A08/MF A01

The application of an end-effector mounted on a service manipulator system was investigated, and requirements for the service end-effector subsystem for in-orbit servicing, comprising the end-effector and the associated tools to perform the tasks, were identified. As a result of trade-offs a design was selected, and was developed further resulting in a new design with assembly drawings of the basic end-effector containing the grapple mechanism, the grapple fixture, the integrated service tool, the connector drive unit and the electronic box. The service tools, the definition of the interface between grapple fixture and service tool or orbit replaceable unit, the locking of the service tool in the tool rack for the back-up integrated service tool, and two preliminary designs of service tools, i.e., the multifunctional gripper and the angled wrench, are described.

Royal Netherlands Aircraft Factories Fokker, N87-25337# Amsterdam. Attitude Control Dept.

END EFFECTOR DEVELOPMENT STUDY. VOLUME 3:

**APPENDICES Final Report** AAD VANSWIETEN Paris, France ESA 15 Jul. 1986 235 p

(Contract ESA-1682/84-NL-AN) (FOK-TR-R-86-091-VOL-3; ESA-CR(P)-2346-VOL-3;

ETN-87-99888) Avail: NTIS HC A11/MF A01

This third of three volumes presents the appendices of the other two volumes. The design rationale of the end effector concept; the multifunctional gripper; the angled wrench; logistic operations; maintenance and repair; assembly; and electrical architecture are discussed.

National Aeronautics and Space Administration. N87-25583\*# John F. Kennedy Space Center, Cocoa Beach, Fla.

QUICK-DISCONNECT INFLATABLE SEAL ASSEMBLY Patent Application

KURT D. BUEHLER, inventor (to NASA) and JAMES E. FESMIRE, inventor (to NASA) 22 May 1987 20 p (NASA-CASE-KSC-11368-1; US-PATENT-APPL-SN-052940)

Avail: NTIS HC A02/MF A01 CSCL 11A

The present invention concerns an inflatable seal assembly adapted for use with a bayonet quick-disconnect system particularly useful for the insulated transfer of cryogenic consumables in orbit (such as between a space station and a re-supply vehicle). The zero-leak cryogenic coupling includes a polymeric seal clamped to a male bayonet member with two pairs of tightening rings. The tightening rings threadably engage each other in respective pairs around tapered ends of the inflatable seal member so that a wedging action tightens the seal member about the male bayonet. Once in place, the seal may be inflated via an inflation port so that its expansion provides pressure contact with the inside surface NASA of a coaxial female member.

#### N87-26355 Rochester Univ., N. Y. SELF-CALIBRATION STRATEGIES FOR ROBOT MANIPULATORS Ph.D. Thesis

AMITABHA MUKERJEE 1986 114 p Avail: Univ. Microfilms Order No. DA8708242

One of the requirements of intelligent machines is the ability to adapt to changes in themselves. This ability is called self-calibration to emphasize its autonomous nature. A self-calibration methodology was developed for the class of mechanisms called active articulated chains, which includes robot manipulators, teleoperators and space structures. The two parts of this effort are: (1) estimating the link inertias, and (2) modeling the friction at manipulator joints. Inertia parameters are determined using the equations of motion for each link. These equations are linear in the inertia parameters and the generalized least squares approach was used to solve for them. The inputs are joint reaction forces, obtained through load sensors. Link velocities and accelerations are used to determine the mapping between the joint reactions and the inertia parameters. Singularity parameters are automatically removed from the calibration model. The calibration algorithm does not require the manipulator to execute any particular motion, although the efficiency of calibration will depend on the nature of the movement. Simulation tests were performed to test the robustness of the algorithm against sensor Dissert. Abstr. N87-26968# Naval Postgraduate School, Monterey, Calif. COMPUTER SIMULATION OF A ROTATIONAL SINGLE-ELEMENT FLEXIBLE SPACECRAFT BOOM M.S. Thesis

ROBERT S. LAUFENBERG Mar. 1987 91 p (AD-A181798) Avail: NTIS HC A05/MF A01 CSCL 22B

The requirement to develop a space based remote ocean sensing platform exists within the Department of the Navy. This project models a satellite subsystem with structural flexibility utilizing the Equivalent Rigid Link System (ERLS). Dynamic analysis with computer simulation is presented for a simple flexible boom rotating in three dimensions with and without a point mass at the boom tip.

Author (GRA)

N87-27408# Oak Ridge National Lab., Tenn.
REMOTE HANDLING FACILITY AND EQUIPMENT USED FOR
SPACE TRUSS ASSEMBLY

T. W. BURGESS 1987 8 p Presented at the Goddard Conference on Space Applications of Artificial Intelligence and Robotics, Greenbelt, Md., 14 May 1987 (Contract DE-AC05-84OR-21400)

(DE87-009121; CONF-870591-3) Avail: NTIS HC A02/MF A01 The ACCESS truss remote handling experiments were performed at Oak Ridge National Laboratory's (ORNL's) Remote Operation and Maintenance Demonstration (ROMD) facility. The ROMD facility has been developed by the US Department of Energy's (DOE's) Consolidated Fuel Reprocessing Program to develop and demonstrate remote maintenance techniques for advanced nuclear fuel reprocessing equipment and other programs of national interest. The facility is a large-volume, high-bay area that encloses a complete, technologically advanced remote maintenance system that first began operation in FY 1982. The maintenance system consists of a full complement of teleoperated manipulators, manipulator transport systems, and overhead hoists that provide the capability of performing a large variety of remote handling tasks. ACCESS truss remote assembly was performed in the ROMD facility using the Central Research Laboratory's (CRL) model M-2 servomanipulator. The model M-2 is a dual-arm, bilateral force-reflecting, master/slave servomanipulator which was jointly developed by CRL and ORNL and represents the state of the art in teleoperated manipulators commercially available in the United States today. The model M-2 servomanipulator incorporates a distributed, microprocessor-based digital control system and was the first successful implementation of an entirely digitally controlled servomanipulator. The system has been in operation since FY

N87-28260# Sener S.A., Madrid (Spain).
SERVICE MANIPULATOR ARM (SMA) FOR A ROBOTIC
SERVICING EXPERIMENT (ROSE) Final Report

1983.

M. FUENTES, C. COMPOSTIZO, F. DOBLAS, A. MARTINEZ, E. DELAFUENTE, R. GONZALO, J. L. LACOMBE, G. BERGER, and T. BLAIS Paris, France ESA Jun. 1986 106 p (Contract ESTEC-6174/85-NL-AN(SC))

(ESA-CR(P)-2347; ETN-87-99994) Avail: NTIS HC A06/MF A01
The most important features of the Robotic Servicing
Experiment (ROSE), where the servicing equipment such as the
Service Manipulator System and the Orbit Replacement Units and
the servicing operations are demonstrated in orbit within a
representative scenario are identified. The shuttle was selected to
carry all the necessary hardware and software into orbit and to
provide resources required by the experiments. The in orbit operator
will be located in the shuttle cabin or in a pressurized module
close to the half pallet where the ROSE elements will be mounted
inside the cargo bay. The ROSE and service manipulator arm
development programs are outlined.

**N87-29009**# Societe Europeenne de Propulsion, Vernon (France).

SPOT/MEGS DESIGN AND FLIGHT RESULTS OBTAINED

G. ATLAS and M. SOULIAC (MATRA Espace, Paris-Velizy, France) In ESA Proceedings of the Fifth European Symposium on

Photovoltaic Generators in Space p 359-364 Nov. 1986 Avail: NTIS HC A21/MF A01

The SPOT MEGS rotation actuator, whose purpose is to ensure that the solar array is always perpendicular to the solar flux, is described. Solar arrays on the SPOT satellites are very flexible, and can be easily excited by the motors that are fitted in the MEGS. To avoid speed stability troubles, a synchronous motor was selected, fed with a compensated current waveform, which leads to a smoother motion of the solar array. Consequently, ultra precise photographs can be taken without stops for repositioning of the satellite. The specifications, performances of MEGS, the stabilization method, and MEGS behavior in orbit are summarized.

N87-29118\* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

MOBILE REMOTE MANIPULATOR VEHICLE SYSTEM Patent
HAROLD G. BUSH, inventor (to NASA), MARTIN M. MIKULAS,
JR., inventor (to NASA), RICHARD E. WALLSOM, inventor (to NASA), and J. KERMIT JENSEN, inventor (to NASA) (Kentron International, Inc., Hampton, Va.) 11 Aug. 1987 17 p Filed
31 Jul. 1985 Supersedes N86-21147 (24 - 11, p 1842)
(NASA-CASE-LAR-13393-1; US-PATENT-4,685,535;
US-PATENT-APPL-SN-760799; US-PATENT-CLASS-182-63;
US-PATENT-CLASS-182-82; US-PATENT-CLASS-182-223)
Avail: US Patent and Trademark Office CSCL 05H

A mobile remote manipulator system is disclosed for assembly, repair and logistics transport on, around and about a space station square bay truss structure. The vehicle is supported by a square track arrangement supported by guide pins integral with the space station truss structure and located at each truss node. Propulsion is provided by a central push-pull drive mechanism that extends out from the vehicle one full structural bay over the truss and locks drive rods into the guide pins. The draw bar is now retracted and the mobile remote manipulator system is pulled onto the next adjacent structural bay. Thus, translation of the vehicle is inchworm style. The drive bar can be locked onto two guide pins while the extendable draw bar is within the vehicle and then push the vehicle away one bay providing bidirectional push-pull drive. The track switches allow the vehicle to travel in two orthogonal directions over the truss structure which coupled with the bidirectional drive, allow movement in four directions on one plane. The top layer of this trilayered vehicle is a logistics platform. This platform is capable of 369 degees of rotation and will have two astronaut foot restraint platforms and a space crane integral.

N87-29593\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SPACE STATION END EFFECTOR STRATEGY STUDY STEPHEN J. KATZBERG, ROBERT L. JENSEN, KELLI F. WILLSHIRE, and ROBERT E. SATTERTHWAITE Aug. 1987 91 P

(NASA-TM-100488; NAS 1.15:100488) Avail: NTIS HC A05/MF A01 CSCL 22B

The results of a study are presented for terminology definition, identification of functional requirements, technolgy assessment, and proposed end effector development strategies for the Space Station Program. The study is composed of a survey of available or under-developed end effector technology, identification of requirements from baselined Space Station documents, a comparative assessment of the match between technology and requirements, and recommended strategies for end effector development for the Space Station Program.

N87-29858\*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. THE 21ST AEROSPACE MECHANISMS SYMPOSIUM

May 1987 356 p Symposium held in Houston, Tex., 29 Apr. - 1 May 1987; sponsored by NASA, California Inst. of Tech., and LMSC

(NASA-CP-2470; S-560; NAS 1.55:2470) Avail: NTIS HC A16/MF A01 CSCL 20K

During the symposium technical topics addressed included

#### 10 MECHANISMS, AUTOMATION, AND ARTIFICIAL INTELLIGENCE

deployable structures, electromagnetic devices, tribology, actuators, latching devices, positioning mechanisms, robotic manipulators, and automated mechanisms synthesis. A summary of the 20th Aerospace Mechanisms Symposium panel discussions is included as an appendix. However, panel discussions on robotics for space and large space structures which were held are not presented herein.

N87-29865\*# Rockwell International Corp., Downey, Calif. Space Station Systems Div.

THE DESIGN AND DEVELOPMENT OF A MOBILE
TRANSPORTER SYSTEM FOR THE SPACE STATION REMOTE
MANIPULATOR SYSTEM

THOMAS W. CARROLL In NASA-Lyndon B. Johnson Space Center, The 21st Aerospace Mechanisms Symposium p 93-101 May 1987

Avail: NTIS HC A16/MF A01 CSCL 05H

The analyses, selection process, and conceptual design of potential candidate Mobile Transporter (MT) systems to move the Space Station Remote Manipulator System (SSRMS) about the exposed faces of the Space Station truss structure are described. The actual requirements for a manipulator system on the space station are discussed, including potential tasks to be performed. The SSRMS operating environment and control methods are analyzed with potential design solutions highlighted. Three general categories of transporter systems are identified and analyzed. Several design solution have emerged that will satisfy these requirements. Their relative merits are discussed, and unique variations in each system are rated for functionality.

N87-29866\*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. TELEROBOTIC WORK SYSTEM: CONCEPT DEVELOPMENT

AND EVOLUTION
LYLE M. JENKINS In its The 21st Aerospace Mechanisms
Symposium p 103-110 May 1987

Avail: NTIS HC A16/MF A01 CSCL 05H

The basic concept of a telerobotic work system (TWS) consists of two dexterous manipulator arms controlled from a remote station. The term telerobotic describes a system that is a combination of teleoperator control and robotic operation. Work represents the function of producing physical changes. System describes the integration of components and subsystems to effectively accomplish the needed mission. Telerobotics reduces exposure to hazards for flight crewmembers and increases their productivity. The requirements for the TWS are derived from both the mission needs and the functional capabilities of existing hardware and software to meet those needs. The development of the TWS is discussed.

N87-29867\*# Martin Marietta Energy Systems, Inc., Oak Ridge,

TRACTION-DRIVE, SEVEN-DEGREE-OF-FREEDOM TELEROBOT ARM: A CONCEPT FOR MANIPULATION IN SPACE

D. P. KUBAN and D. M. WILLIAMS In NASA-Lyndon B. Johnson Space Center, The 21st Aerospace Mechanisms Symposium p 111-130 May 1987

Avail: NTIS HC A16/MF A01 CSCL 05H

As man seeks to expand his dominion into new environments, the demand increases for machines that perform useful functions in remote locations. This new concept for manipulation in space is based on knowledge and experience gained from manipulator systems developed to meet the needs of remote nuclear applications. It merges the best characteristics of teleoperation and robotic technologies. The design goals for the telerobot, a mechanical description, and technology areas that must be addressed for successful implementation are presented and discussed. The concept incorporates mechanical traction drives, redundant kinematics, and modular arm subelements to provide a backlash-free manipulator capable of obstacle avoidance.

**Author** 

N87-29868\*# Societe Europeenne de Propulsion, Vernon (France).

EXPERIENCES OF CNES AND SEP ON SPACE MECHANISMS ROTATING AT LOW SPEED

G. ATLAS and G. THOMIN (Centre National d'Etudes Spatiales, Toulouse, France) In NASA-Lyndon B. Johnson Space Center, The 21st Aerospace Mechanisms Symposium p 131-144 May 1987

Avail: NTIS HC A16/MF A01 CSCL 13I

Some aspects of knowledge acquired in the field of space mechanisms by Societe Europeenne de Propulsion and Centre National d'Etudes Spatiales in International and French National space programs are described. The experience described centers on the development of these programs: The MEGS (Mechanisme d'Etrainement du Generateur Solaire), and the MOGS (Mechanisme d'Orientation de Generateur Solaire), both solar array drive mechanisms. Key design areas and the mechanism performance obtained are highlighted. Some test problems with the MEGS sliprings are discussed.

N87-29869\*# Sperry Space Systems, Durham, N.C. COMMON DRIVE UNIT

R. C. ELLIS, R. A. FINK, and E. A. MOORE *In* NASA-Lyndon B. Johnson Space Center, The 21st Aerospace Mechanisms Symposium p 145-163 May 1987
Avail: NTIS HC A16/MF A01 CSCL 13I

The Common Drive Unit (CDU) is a high reliability rotary actuator with many versatile applications in mechanism designs. The CDU incorporates a set of redundant motor-brake assemblies driving a single output shaft through differential. Tachometers provide speed information in the AC version. Operation of both motors, as compared to the operation of one motor, will yield the same output torque with twice the output speed.

N87-29879\*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. SPACE STATION LUBRICATION CONSIDERATIONS

LUBERT J. LEGER and KEITH DUFRANE (Battelle Columbus Labs., Ohio.) In its The 21st Aerospace Mechanisms Symposium p 285-294 May 1987

Avail: NTIS HC A16/MF A01 CSCL 22B

Future activities in space will require the use of large structures and high power availability in order to fully exploit opportunities in Earth and stellar observations, space manufacturing and the development of optimum space transportation vehicles. Although these large systems will have increased capabilities, the associated development costs will be high, and will dictate long life with minimum maintenance. The Space Station provides a concrete example of such a system; it is approximately one hundred meters in major dimensions and has a life requirement of thirty years. Numerous mechanical components will be associated with these systems, a portion of which will be exposed to the space environment. If the long life and low maintenance goals are to be satisfied, lubricants and lubrication concepts will have to be carefully selected. Current lubrication practices are reviewed with the intent of determining acceptability for the long life requirements. The effects of exposure of lubricants and lubricant binders to the space environment are generally discussed. Potential interaction of MoS2 with atomic oxygen, a component of the low Earth orbit environment, appears to be significant.

#### 11

#### **MATERIALS**

Includes mechanical properties of materials, and descriptions and analyses of different structural materials, films, coatings, bonding materials and descriptions of the effects of natural and induced space environments.

#### A87-32059

THE VANDERBILT UNIVERSITY NEUTRAL O-BEAM FACILITY C. L. JOHNSON, R. G. ALBRIDGE, A. V. BARNES, R. K. COLE, D. J. DEAN (Vanderbilt University, Nashville, TN) et al. SAMPE Quarterly (ISSN 0036-0821), vol. 18, Jan. 1987, p. 35-40. Research supported by Martin Marietta Corp. refs

As part of a study of the effects of atomic oxygen on spacecraft surfaces in low earth orbit, a novel method for the laboratory production of low-energy beams of neutral atomic oxygen by a facility that uses a mixture of 90 percent helium and 10 percent oxygen was developed. Beams of He(+), O(+), and O2(+) ions produced by the facility are extracted, accelerated, and mass-selected by crossed electric and magnetic fields. Neutralization of the decelerated beams is accomplished by means of an electron transfer from a flat metal surface which the beams strike at a grazing-incidence angle. The procedure produces pure neutral atomic beams that are focused and monoenergetic. As examples of studies of the effects of atomic oxygen on space-relevant materials, the optical spectra resulting from interactions of a beam of 2.5-keV neutral oxygen atoms and a beam of 5.0-keV oxygen ions incident on a Kapton film sample are presented.

#### A87-32060

## HIGH INTENSITY 5 EV CW LASER SUSTAINED 0-ATOM EXPOSURE FACILITY FOR MATERIAL DEGRADATION STUDIES

J. B. CROSS, L. H. SPANGLER, M. A. HOFFBAUER, and F. A. ARCHULETA (Los Alamos National Laboratory, NM) SAMPE Quarterly (ISSN 0036-0821), vol. 18, Jan. 1987, p. 41-47. refs

An atomic oxygen exposure facility has been developed for studies of material degradation. The goal of these studies is to provide design criteria and information for the manufacture of long life (20 to 30 years) construction material for use in low earth orbit. The studies that are being undertaken using the facility will provide: (1) absolute reaction cross sections for use in engineering design problems, (2) formulations of reaction mechanisms for use in selection of suitable existing materials and design of new more resistant ones, and (3) calibration of flight hardware (mass spectrometers, etc.) in order to directly relate experiments performed in low earth orbit to ground based investigations.

**Author** 

# A87-32061\* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. SELECTED MATERIALS ISSUES ASSOCIATED WITH SPACE STATION

L. LEGER, J. VISENTINE, and B. SANTOS-MASON (NASA, Johnson Space Center, Houston, TX) SAMPE Quarterly (ISSN 0036-0821), vol. 18, Jan. 1987, p. 48-54. refs

Compatibility of Space Station hardware with the space environment is one of the major materials development issues. The projected long life of the Space Station elements (about 30 years for structural components and 20 years for power systems), the large number of day/night thermal cycles that have to be withstood during the life of the Station, and the effects of atomic oxygen and UV irradiation on exposed surfaces demand new considerations in selection of materials. Reaction efficiencies of materials for Space Station applications derived from LEO experiments are presented together with surface recession predictions for various Space Station components. Developments

in the areas of protective coatings and of laboratory facilities for evaluating the effects of atomic oxygen are discussed.

#### A87-32342

#### **DEVELOPMENT OF GRAPHITE EPOXY SPACE STRUCTURE**

MASANOBU YAMAGUCHI, KATSUHIDE KITAMURA, YOSHIKAZU OJIMA (Ishikawajima-Harima Heavy Industries Co., Ltd., Space Development Div., Tokyo, Japan), and TASUKU YAMAGATA (Ishikawajima-Harima Heavy Industries Co., Ltd., Research Institute, Yokohama, Japan) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 1. Tokyo, AGNE Publishing, Inc., 1986, p. 509-514.

This paper describes application of graphite epoxy composites to truss type space structures. The design method of graphite epoxy tube is studied, and influences of the space environment on graphite epoxy composites are discussed. Fiber orientation of unidirectional laminae must be carefully selected in order to prevent transverse cracks from arising. A basic structure of truss type space structure which is 1.5 m long, 0.75 m wide, and 0.75 m high was manufactured.

A87-33100\*# Rome Air Development Center, Hanscom AFB, Mass.

### SPACECRAFT DIELECTRIC MATERIAL PROPERTIES AND SPACECRAFT CHARGING

A. R. FREDERICKSON, J. A. WALL (USAF, Rome Air Development Center, Bedford, MA), D. B. COTTS (SRI International, Menlo Park, CA), and F. L. BOUQUET (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) Research supported by USAF and NASA. New York, American Institute of Aeronautics and Astronautics, Inc. (Progress in Astronautics and Aeronautics. Volume 107), 1986, 89 p. refs

The physics of spacecraft charging is reviewed, and criteria for selecting and testing semiinsulating polymers (SIPs) to avoid charging are discussed and illustrated. Chapters are devoted to the required properties of dielectric materials, the charging process, discharge-pulse phenomena, design for minimum pulse size, design to prevent pulses, conduction in polymers, evaluation of SIPs that might prevent spacecraft charging, and the general response of dielectrics to space radiation. SIPs characterized include polymides, fluorocarbons, thermoplastic polyesters, poly(alkanes), vinyl polymers and acrylates, polymers containing phthalocyanine, polyacene quinones, coordination polymers containing metal ions, conjugated-backbone polymers, and 'metallic' conducting polymers. Tables summarizing the results of SIP radiation tests (such as those performed for the NASA Galileo Project) are included.

T.K.

#### A87-33639#

## EFFECT OF TRANSVERSE SHEARING FORCES ON BUCKLING AND POSTBUCKLING OF DELAMINATED COMPOSITES UNDER COMPRESSIVE LOADS

G. A. KARDOMATEAS and D. W. SCHMUESER (GM Research Laboratories, Warren, MI) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987, Technical Papers. Part 1. New York, American Institute of Aeronautics and Astronautics, 1987, p. 757-765. refs (AIAA PAPER 87-0877)

The deformation of delaminated composites under axial compression is analyzed by a one-dimensional beam-plate model. In this model, a formulation that accounts for the transverse shear effects is also presented. Using the perturbation technique, analytical solutions for the critical instability load and the postbuckling deflections are obtained. All possible instability modes, namely local delamination buckling, global plate buckling and coupled global and local (mixed) buckling are considered. Specific emphasis is placed on studying the transverse shear effects on both the critical load and the postcritical characteristics, as well as the influence of the geometry such as that of the location of the delamination across the thickness. The postbuckling solution is used in conjunction with a J-integral formulation to study the

postcritical characteristics with respect to possible quasi-static extension of the delamination and the energy absorption capacity of a beam.

A87-38625\* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

### PRODUCTION OF PULSED ATOMIC OXYGEN BEAMS VIA LASER VAPORIZATION METHODS

DAVID E. BRINZA, DANIEL R. COULTER, RANTY H. LIANG, and AMITAVA GUPTA (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: International SAMPE Technical Conference, 18th, Seattle, WA, Oct. 7-9, 1986, Proceedings. Covina, CA, Society for the Advancement of Material and Process Engineering, 1986, p. 769-779. refs

The generation of energetic pulsed atomic oxygen beams by laser-driven evaporation of cryogenically frozen ozone/oxygen films and thin indium-tin oxide (ITO) films is reported. Mass spectroscopy is used in the mass and energy characterization of beams from the ozone/oxygen films, and a peak flux of 3 x 10 to the 20th/sq m per sec at 10 eV is found. Analysis of the time-of-flight data suggests that several processes contribute to the formation of the oxygen beam. Results show the absence of metastable states such as the 2p(3)3s(1)(5S) level of atomic oxygen blown-off from the ITO films. The present process has application to the study of the oxygen degradation problem of LEO materials.

A87-38641\* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

#### **DEGRADATION STUDIES OF SMRM TEFLON**

RANTY H. LIANG, KERI L. ODA, SHIRLEY Y. CHUNG, and AMITAVA GUPTA (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: International SAMPE Technical Conference, 18th, Seattle, WA, Oct. 7-9, 1986, Proceedings. Covina, CA, Society for the Advancement of Material and Process Engineering, 1986, p. 1050-1055.

Teflon samples returned from the Solar Max Satellite (SMS) suffered noticeable damage such as cracking and yellowing. This is in contrast to teflon exposed aboard STS-5 and STS-8 which showed no detectable changes. Selected teflon tape samples from SMS were studied to evaluate the extent and mechanism of degradation. ESCA studies revealed that these teflon samples contain hydrocarbon segments which were susceptible to oxygen atom degradation. Mechanical measurements also showed bulk property changes as a result of LEO exposure. A molecular model of material and energetic oxygen atom interaction was proposed. SMS data and the importance of developing correlation between accelerated exposure data from STS and ground-based testing and real time data will be presented.

#### A87-38642 STRUCTURE-PROPERTY RELATIONSHIPS IN POLYMER RESISTANCE TO ATOMIC OXYGEN

LARRY P. TORRE and H. GARY PIPPIN (Boeing Aerospace Co., Seattle, WA) IN: International SAMPE Technical Conference, 18th, Seattle, WA, Oct. 7-9, 1986, Proceedings . Covina, CA, Society for the Advancement of Material and Process Engineering, 1986, p. 1086-1100. refs

A theory based on the surface recombination of atomic oxygen is proposed to partially explain the degradation of materials in LEO, with application to the development of space-base materials. Such recombination processes can provide up to 5.07 eV to a chemical bond, and are shown to account for many of the observations of degradation. Previous results show the contribution of bond strengths (of greater than 4.2 eV), fluoridation, and bulky side groups to the resistance of certain polymers to attack by atomic oxygen.

#### A87-39426# EFFECT OF LONG-TERM EXPOSURE TO LEO SPACE ENVIRONMENT ON SPACECRAFT MATERIALS

D. G. ZIMCIK (CDC, Communications Research Centre, Ottawa, Canada) Canadian Aeronautics and Space Journal (ISSN 0008-2821), vol. 33, March 1987, p. 4-10. refs

The resistance of some polymeric materials to the LEO environment is evaluated. Long-term exposure data obtained from components and materials from the SMM satellite are compared with data obtained from the Advanced Composite Material Exposure to Space Experiment flown Shuttle mission STS-41G. The Modular Attitude Control System for the SMM satellite, which contains Kapton, Teflon, and Chemglaze Z306, and specimens of Kapton and Chemolaze Z306 from the STS-41G mission are analyzed. It is observed that the reaction rate for surface degradation of Kapton in both experiments correlate well. The changes in the morphology of the silver-backed Teflon second surface mirrors of the SMM satelltie are examined. The absorptance/emittance ratio for Kapton, Teflon, and Chemglaze Z306 are calculated and studied. The data reveal that there are changes in the Kapton and Teflon ratios; however, for the Chemglaze no significant differences in the absorptance/emittance ratio are detected.

## A87-41022 MICROCRACK RESISTANT STRUCTURAL COMPOSITE TUBES FOR SPACE APPLICATIONS

HENRY W. BABEL, TIMOTHY P. SHUMATE, and DANIEL F. THOMPSON (McDonnell Douglas Astronautics Co., Huntington Beach, CA) SAMPE Journal (ISSN 0091-1062), vol. 23, May-June 1987, p. 43-48. refs

A program was initiated and is continuing to evaluate and select carbon fiber/resin combinations which would not microcrack when exposed to the temperature variations encountered in space. Service temperatures were analytically predicted for anodized aluminum and Teflon coatings. Proven MY720/DDS type resins, new toughened resins with high residual compression strength after impact and resins which permit low cost processing were selected for evaluation. A 1000-cycle screening test program from room temperature to -157 C was initiated to evaluate the microcracking resistance of the candidate resins. Selected candidates will be identified for a long term verification test program in which cyclic temperatures expected in space will be used. Three of the material systems tested during 1986 exhibited test induced microcracking. Several of the test specimens that cracked had processing related defects present prior to testing. Additional testing will be conducted during 1987 to determine if the preexisting defects contributed to the observed cracking.

### A87-44741 MATERIALS FOR SPACE APPLICATIONS

M. D. JUDD (ESA, Product Assurance Div., Noordwijk, Netherlands) IN: Materials in aerospace; Proceedings of the First International Conference, London, England, Apr. 2-4, 1986. Volume 2 . London, Royal Aeronautical Society, 1986, p. 240-248.

An account is given of aerospace industry performance requirements for materials that are to be subjected to orbital space conditions as constituents of such spacecraft as Columbus and Hermes. The residual oxygen atoms in low earth orbit can drastically degrade a number of otherwise structurally useful polymeric materials; such effects will be felt in combination with high UV ionizing radiation fluxes, vacuum-outgassing conditions, etc. Instances of materials currently being developed to meet space requirements are solar cell and cover glass adhesives with low outgassing properties, conductive and nonconductive thermal control paints with good UV radiation stability, and UV exposure-curing resin systems for inflatable antenna construction.

## A87-49797\* Massachusetts Inst. of Tech., Cambridge. MATERIAL DAMPING IN ALUMINUM AND METAL MATRIX COMPOSITES

EDWARD F. CRAWLEY and MARTHINUS C. VAN SCHOOR (MIT, Cambridge, MA) Journal of Composite Materials (ISSN 0021-9983), vol. 21, June 1987, p. 553-568. Research supported by Textron, Inc. refs (Contract NAGW-21)

The material damping in beam-like specimens of aluminum and metal matrix composites was measured. A unique apparatus to

determine damping by free decay while the specimens are in free fall in a vacuum was used. The specimens tested include 2024-T3 and 6061-T4 aluminum, and unidirectional graphite/metal matrix specimens with P55 and P100 fibers and 6061 Aluminum and AZ91C Magnesium as matrix materials. Tests were conducted to determine the dependence of damping on frequency and stress level. For the aluminum specimens, the material damping followed the Zener model at very low stress levels. Below the Zener relaxation frequency, a strong dependence of damping on stress was found for even moderate stress levels. Damping for the aluminum matrix materials was slightly above that predicted by the Zener model for a homogeneous bar of the matrix aluminum. For the magnesium matrix specimens, damping significantly above the Zener prediction for the homogeneous matrix material was observed.

#### A87-51772

## DEVELOPMENT OF METAL MATRIX COMPOSITES IN R & D INSTITUTE OF METALS & COMPOSITES FOR FUTURE INDUSTRIES

YOSHIO MINODA (Research and Development Institut of Metals and Composites for Future Industries, Tokyo, Japan) IN: Composites '86: Recent advances in Japan and the United States; Proceedings of the Third Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 23-25, 1986. Tokyo, Japan Society for Composite Materials, 1986, p. 475-481.

The latest status of a research and development program to develop basic industrial technology for metal matrix composites suitable for aerospace structures in the 1990's is discussed. Findings to date and remaining problems in the three parts of the program are summarized, including the development of graphite/Al and SiC (Nicalon)/Al preformed wires, the development of primary forming technology for them, and related structural or quality evaluation technologies necessary for application to end items. It has been found that both aluminum-infiltrated graphite and SiC (Nicalon) yarn seem to be very useful intermediate material for producing metal matrix composites. Titanium matrix composites show superior mechanical properties compared to aluminum matrix composites.

#### A87-51794

## TAYLORED LAMINATES WITH NULL OR ARBITRARY COEFFICIENT OF THERMAL EXPANSION

TAKASHI ISHIKAWA and HISAO FUKUNAGA (National Aerospace Laboratory, Chofu, Japan) IN: Composites '86: Recent advances in Japan and the United States; Proceedings of the Third Japan-U.S. Conference on Composite Materials, Tokyo, Japan, June 23-25, 1986. Tokyo, Japan Society for Composite Materials, 1986, p. 701-708. refs

A lamination tayloring theory is proposed in order to control the coefficient of thermal expansion of graphite/epoxy composites in a principal direction. This technique consists of the concepts of thermoelastic invariants and lamination parameters. The expansion-free condition yields to a parabola in the feasible region of the lamination parameters. The calculated curves for a wide range of temperature intersect almost at a point. A laminate with the lay-up construction corresponding to this point will exhibit an approximately null coefficient in one direction in that temperature range. Some preliminary experimental results indicate that the present procedure is possible and promising. The taylored material will be appropriate for the Space Station.

#### A87-53946

### TESTING OF MATERIALS FOR SOLAR POWER SPACE APPLICATIONS

BRUCE J. FARADAY, RICHARD L. STATLER, and DELORES H. WALKER (U.S. Navy, Naval Research Laboratory, Washington, DC) Solar Energy Materials (ISSN 0165-1633), vol. 15, July 1987, p. 313-336. refs

This paper summarizes the results of a program initiated at the Naval Research Laboratory to test conventional and state-of-the-art solar power space systems by flying them aboard satellites. The program confirmed the practicality of improvements

in advanced Si solar cells such as textured surfaces, shallow junctions, back surface field, and back surface reflector techniques. The performance of GaAlAs solar cells was demonstrated to be satisfactory. Finally, advanced Si cells such as Li-diffused and vertical junction cells were found unsuitable for extended space application.

Author

N87-23736\* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

OXIDATION PROTECTION COATINGS FOR POLYMERS Patent JAMES S. SOVEY, inventor (to NASA), BRUCE A. BANKS, inventor (to NASA), and MICHAEL J. MIRTICH, inventor (to NASA) 12 May 1987 7 p Filed 27 Feb. 1986 Supersedes N86-26434 (24 - 17, p 2709)

Division of US-Patent-4,604,181, Patent-Appl-SN-761235, which is a division of US-Patent-4,560,577, US-Patent-Appl-SN-649330 (NASA-CASE-LEW-14072-3; US-PATENT-4,664,980;

A polymeric substrate is coated with a metal oxide film to provide oxidation protection in low Earth orbital environments. The film contains about four volume percent polymer to provide flexibility.

NASA

N87-25430# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany).

#### FIBER COMPÓSITES IN SATELLITES

ARMIN SCHEDLER 28 Jul. 1986 16 p Presented at the Conference on ICMC Nonmetallic Materials and Composites at Low Temperatures 4, Heidelberg, West Germany, 28-29 Jul. 1986 (MBB-UD-492/86; ETN-87-99932) Avail: Issuing Activity

The advantages of the low specific weight, high strength, and adjustable values of stiffness, thermal expansion, and thermal conductivity of fiber composites for spacecraft construction are reviewed. Utilizations between 4 and 450K are illustrated. ESA

N87-25480\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

### AN EVALUATION OF CANDIDATE OXIDATION RESISTANT MATERIALS FOR SPACE APPLICATIONS IN LEO

SHARON RUTLEDGE, BRUCE BANKS, FRANK DIFILIPPO, JOYCE BRADY, THERESE DEVER, and DEBORAH HOTES (Cleveland State Univ., Ohio.) 1986 16 p Presented at the Workshop on Atomic Oxygen Effects, Pasadena, Calif., 10-11 Nov. 1986; sponsored by JPL

(NASA-TM-100122; E-3669; NAS 1.15:100122) Avail: NTIS HC A02/MF A01 CSCL 11C

Ground based testing of materials considered for polyimide (Kapton) solar array blanket protection and graphite-epoxy stroctural member protection was performed in an RF plasma asher. Protective coatings on Kapton from various commercial sources and from NASA Lewis Research Center were exposed to the air plasma; and mass loss per unit area was measured for each sample. All samples evaluated provided some protection to the underlying surface, but metal-oxide-fluoropolymer coatings provided the best protection by exhibiting very little degradation after 47 hr of asher exposure. Mica paint was evaluated as a protective coating for graphite-epoxy structural members. Mica appeared to be resistant to attack by atomic oxygen, but only offered limited protection as a paint, this is believed to be due to the paint vehicle ashing underneath the mica leaving unattached mica flakes lying on the surface. The protective coatings on Kapton evaluated so far are promising but further research on protection of graphite-epoxy support structures is needed.

N87-25586\*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

BI-STEM GRIPPING APPARATUS Patent Application
FRED G. SANDERS, inventor (to NASA) 3 Jun. 1987 13 p
(NASA-CASE-MFS-28185-1; US-PATENT-APPL-SN-056930)
Avail: NTIS HC A02/MF A01 CSCL 131

#### 11 MATERIALS

This invention relates to devices which grip cylindrical structures and more particularly to a device which has three arcuate gripping members having frictional surfaces for gripping and compressing a bi-stem. The bi-stem gripping apparatus is constructed having a pair of side gripping members, and an intermediate gripping member disposed between them. Sheets of a gum stock silicone rubber with frictional gripping surfaces are bonded to the inner region of the gripping members and provide frictional engagement between the bi-stem and the apparatus. A latch secures the gripping apparatus to a bi-stem, and removable handles are attached, allowing an astronaut to pull the bi-stem from its cassette. A tethering ring on the outside of the gripping apparatus provides a convenient point to which a lanyard may be attached.

N87-26175\*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

MATERIAL INTERACTIONS WITH THE LOW EARTH ORBITAL (LEO) ENVIRONMENT: ACCURATE REACTION RATE MEASUREMENTS

JAMES T. VISENTINE and LUBERT J. LEGER In Jet Propulsion Lab., Proceedings of the NASA Workshop on Atomic Oxygen Effects p 11-20 1 Jun. 1987

Avail: NTIS HC A09/MF A01 CSCL 07D

To resolve uncertainties in estimated LEO atomic oxygen fluence and provide reaction product composition data for comparison to data obtained in ground-based simulation laboratories, a flight experiment has been proposed for the space shuttle which utilizes an ion-neutral mass spectrometer to obtain in-situ ambient density measurements and identify reaction products from modeled polymers exposed to the atomic oxygen environment. An overview of this experiment is presented and the methodology of calibrating the flight mass spectrometer in a neutral beam facility prior to its use on the space shuttle is established. The experiment, designated EOIM-3 (Evaluation of Oxygen Interactions with Materials, third series), will provide a reliable materials interaction data base for future spacecraft design and will furnish insight into the basic chemical mechanisms leading to atomic oxygen interactions with surfaces.

N87-26177\*# Alabama Univ., Huntsville. Dept. of Chemistry.
INTERACTION OF HYPERTHERMAL ATOMS ON SURFACES
IN ORBIT: THE UNIVERSITY OF ALABAMA EXPERIMENT
J. C. GREGORY In Jet Propulsion Lab., Proceedings of the
NASA Workshop on Atomic Oxygen Effects p 29-36 1 Jun.

(Contract NAGW-823; NAGW-812)

Avail: NTIS HC A09/MF A01 CSCL 07D

The University of Alabama experiment which flew on the STS-8 mission had several objectives which were mostly of a speculative nature since so little was known of the processes of interest. The experiment provided original data on: (1) oxidation of metal surfaces; (2) reaction rates of atomic oxygen with carbon and other surfaces and the dependence of these rates on temperature; and (3) the angular distribution of 5 eV atoms scattered off a solid surface. A review of the results is provided.

N87-26180\*# Yale Univ., New Haven, Conn. Dept. of Chemical Engineering.

PRODUCT ENERGY DISTRIBUTIONS AND ENERGY PARTITIONING IN O ATOM REACTIONS ON SURFACES

BRET HALPERN and MORIS KORI In Jet Propulsion Lab., Proceedings of the NASA Workshop on Atomic Oxygen Effects p 55-62 1 Jun. 1987

(Contract NSF CPE-81-14348; PRF-17006-AC5-C; F499620-80-C-0026)

Avail: NTIS HC A09/MF A01 CSCL 07D

Surface reactions involving O atoms are likely to be highly exoergic, with different consequences if energy is channeled mostly to product molecules or surface modes. Thus the surface may become a source of excited species which can react elsewhere, or a sink for localized heat deposition which may disrupt the surface. The vibrational energy distribution of the product molecule contains strong clues about the flow of released energy. Two instructive

examples of energy partitioning at surfaces are the Pt catalyzed oxidations: (1) C(ads) + O(ads) yields CO\* (T is greater than 1000 K); and (2) CO(ads) + O(gas) yields CO2\* (T is approx. 300 K). The infrared emission spectra of the excited product molecules were recorded and the vibrational population distributions were determined. In reaction 1, energy appeared to be statistically partitioned between the product CO and several Pt atoms. In reaction 2, partitioning was non-statistical; the CO2 asymmetric stretch distribution was inverted. In gas reactions these results would indicate a long lived and short lived activated complex. The requirement that Pt be heated in O atoms to promote reaction of atomic O and CO at room temperature is specifically addressed. Finally, the fraction of released energy that is deposited in the catalyst is estimated.

N87-26182\*# National Aeronautics and Space Administration.

Ames Research Center, Moffett Field, Calif.

POTENTIAL ENERGY SURFACES FOR ATOMIC OXYGEN REACTIONS: FORMATION OF SINGLET AND TRIPLET BIRADICALS AS PRIMARY REACTION PRODUCTS WITH UNSATURATED ORGANIC MOLECULES

RICHARD L. JAFFE In Jet Propulsion Lab., Proceedings of the NASA Workshop on Atomic Oxygen Effects p 75-87 1 Jun. 1987

Avail: NTIS HC A09/MF A01 CSCL 07D

The experimental study of the interaction of atomic oxygen with organic polymer films under LEO conditions has been hampered by the inability to conduct detailed experiments in situ. As a result, studies of the mechanism of oxygen atom reactions have relied on laboratory O-atom sources that do not fully reproduce the orbital environment. For example, it is well established that only ground electronic state O atoms are present at LEO, yet most ground-based sources are known to produce singlet O atoms and molecules and ions in addition to O(3P). Engineers should not rely on such facilities unless it can be demonstrated either that these different O species are inert or that they react in the same fashion as ground state atoms. Ab initio quantum chemical calculations have been aimed at elucidating the biradical intermediates formed during the electrophilic addition of ground and excited-state O atoms to carbon-carbon double bonds in small olefins and aromatic molecules. These biradicals are critical intermediates in any possible insertion, addition and elimination reaction mechanisms. Through these calculations, we will be able to comment on the relative importance of these pathways for O(3P) and O(1D) reactions. The reactions of O atoms with ethylene and benzene are used to illustrate the important features of the mechanisms of atomic oxygen reaction with unsaturated organic compounds and polymeric materials.

N87-26189\*# Physical Sciences, Inc., Andover, Mass. PULSED SOURCE OF ENERGETIC ATOMIC OXYGEN

GEORGE E. CALEDONIA and ROBERT H. KRECH In Jet Propulsion Lab., Proceedings of the NASA Workshop on Atomic Oxygen Effects p 135-142 1 Jun. 1987 (Contract NAS7-936)

Àvail: NTIS HC A09/MF A01 CSCL 07D

A pulsed high flux source of nearly monoenergetic atomic oxygen was designed, built, and successfully demonstrated. Molecular oxygen at several atmospheres pressure is introduced into an evacuated supersonic expansion nozzle through a pulsed molecular beam valve. An 18 J pulsed CO2 TEA laser is focused to intensities greater than 10(9) W/sq cm in the nozzle throat to generate a laser-induced breakdown. The resulting plasma is heated in excess of 20,000 K by a laser supported detonation wave, and then rapidly expands and cools. Nozzle geometry confines the expansion to provide rapid electron-ion recombination into atomic oxygen. Average O atom beam velocities from 5 to 13 km/s were measured at estimated fluxes to 10(18) atoms per pulse. Preliminary materials testing has produced the same surface oxygen enrichment in polyethylene samples as obtained on the STS-8 mission. Scanning electron microscope examinations of irradiated polymer surfaces reveal an erosion morphology similar to that obtained in low Earth orbit, with an estimated mass removal

1987

rate of approx. 10(-24) cu cm/atom. The characteristics of the O atom source and the results of some preliminary materials testing studies are reviewed.

N87-26190\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

### PRODUCTION OF PULSED ATOMIC OXYGEN BEAMS VIA LASER VAPORIZATION METHODS

DAVID E. BRINZA, DANIEL R. COULTER, RANTY H. LIANG, and AMITAVA GUPTA *In its* Proceedings of the NASA Workshop on Atomic Oxygen Effects p 143-150 1 Jun. 1987 Avail: NTIS HC A09/MF A01 CSCL 20E

Energetic pulsed atomic oxygen beams were generated by laser-driven evaporation of cryogenically frozen ozone/oxygen films and thin films of indium-tin oxide (ITO). Mass and energy characterization of beams from the ozone/oxygen films were carried out by mass spectrometry. The peak flux, found to occur at 10 eV, is estimated from this data to be 3 x 10(20) m(-2) s(-1). Analysis of the time-of-flight data indicates a number of processes contribute to the formation of the atomic oxygen beam. The absence of metastable states such as the 2p(3) 3s(1) (5S) level of atomic oxygen blown off from ITO films is supported by the failure to observe emission at 777.3 nm from the 2p(3) 3p(1) (5P sub J) levels. Reactive scattering experiments with polymer film targets for atomic oxygen bombardment are planned using a universal crossed molecular beam apparatus.

N87-26197\*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

REACTIONS OF ATOMIC OXYGEN (O(P-3)) WITH

POLYBUTADIENES AND RELATED POLYMERS Abstract Only MORTON A. GOLUB, NARCINDA R. LERNER, and THEODORE WYDEVEN In Jet Propulsion Lab., Proceedings of the NASA Workshop on Atomic Oxygen Effects p 161 1 Jun. 1987 Avail: NTIS HC A09/MF A01 CSCL 11B

Thin films of the following polymers were exposed at ambient temperature to ground-state oxygen atoms (O(P-3)), generated by a radio-frequency glow discharge in O2: cis- and trans-1,4-polybutadienes (CB and TB), amorphous 1,2-polybutadiene (VB), polybutadienes with different 1,4/1,2 contents, trans polypentenamer (TP), cis and trans polyoctenamers (CO and TO), and ethylene-propylene rubber (EPM). Transmission infrared spectra of CB and TB films revealed extensive surface recession, or etching, unaccompanied by any microstructural changes within the films, demonstrating that the reactions were confined to the surface layers. Contrary to the report by Rabek, Lucki, and Ranby (1979), there was no O(3P)-induced cis-trans isomerization in CB or TB. From weight-loss measurements, etch rates for polybutadienes were found to be markedly dependent on vinyl content, decreasing by two orders of magnitude from CB (2% 1,2) to structures with 30 to 40% 1,2 double bonds, thereafter increasing by half an order of magnitude to VB (97% 1,2), Relative etch rates for EMP and the polyalkenamers were in the order: EMP is greater than CO (or TO) is greater than TP is greater than CB. The sole non-elastomer examined, TB, had an etch rate about six times that of CB, ascribable to a morphology difference. Cis/trans content had a negligible effect on the etch rate of the polyalkenamers. Mechanisms involving crosslinking through units are proposed for the unexpected protection imparted to polybutadienes by the 1,2 double bonds.

Author

## N87-26198\*# Physical Sciences, Inc., Andover, Mass. CHEMICAL INTERACTIONS IN LOW EARTH ORBIT (LEO) Abstract Only

B. D. GREEN In Jet Propulsion Lab., Proceedings of the NASA Workshop on Atomic Oxygen Effects p 162 1 Jun. 1987 Avail: NTIS HC A09/MF A01 CSCL 07D

Although several observations of material changes on-orbit have been reported, mechanistic understanding has not yet become clear because new sets of non-intuitive processes are occurring on orbit. Reactant kinetic energy, low collision rates and surface/adsorbate interactions must be considered in the analysis of these observations. The specific example of oxide formation of

elemental materials is examined in terms of thermodynamics and possible reaction pathways. On the basis of this approach, a rational trend emerges from the orbital behavior of these samples. The role of reactant kinetic energy as opposed to internal energy in chemiluminescent product formation is also presented. Development of a systematic thermochemical approach may be useful in making screening predictions of long-term material behavior on-orbit.

N87-26200\*# Princeton Univ., N. J. Plasma Physics Lab. GROUNDBASED STUDIES OF SPACECRAFT GLOW AND EROSION CAUSED BY IMPACT OF OXYGEN AND NITROGEN BEAMS Abstract Only

W. D. LANGER, S. A. COHEN, D. M. MANOS, R. W. MOTLEY, and S. F. PAUL *In* Jet Propulsion Lab., Proceedings of the NASA Workshop on Atomic Oxygen Effects p 164 1 Jun. 1987 (Contract NAG8-521)

Avail: NTIS HC A09/MF A01 CSCL 22B

To simulate surface reactions in the space environment a ground-based facility was developed that produces a very high flux 10(14) to 10(16)/sq cm/s of low energy (2 to 20 eV) neutral atoms and molecules. The neutral beams are created using a method involving neutralization and reflection of ions from a biased limiter, where the ions are extracted from a toroidal plasma source. The spectra of emission due to beam-solid interactions on targets of Chemglaze Z-306 optical paint and Kapton are presented. Erosion yields for carbon and Kapton targets with low energy (approx. 10 eV) nitrogen and oxygen beams were measured. The reaction rates and surface morphology for the erosion of Kapton are similar to those measured in experiments on STS-5.

N87-26201\*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

POTENTIAL SURFACES FOR O ATOM-POLYMER REACTIONS Abstract Only

B. C. LASKOWSKI (Analatom, Inc., San Jose, Calif.) and R. L. JAFFE *In* Jet Propulsion Lab., Proceedings of the NASA Workshop on Atomic Oxygen Effects p 165 1 Jun. 1987 Avail: NTIS HC A09/MF A01 CSCL 07D

Ab initio quantum chemistry methods are used to study the energetics of interactions of O atoms with organic compounds. Polyethylene (CH2)n has been chosen as the model system to study the interactions of O(3P) and O(1D) atoms with polymers. In particular, H abstraction is investigated and polyethylene is represented by a C3 (propane) oligomeric model. The gradient method, as implemented in the GRADSCF package of programs, is used to determine the geometries and energies of products and reactants. The saddle point, barrier geometry is determined by minimizing the squares of the gradients of the potential with respect to the internal coordinates. To correctly describe the change in bonding during the reaction at least a two configuration (multiconfiguration self consistent field) or GVB (generalized valence bond) wave function has to be used. Basis sets include standard Pople and Dunning sets, however, increased with polarization functions and diffuse p functions on both the C and O atoms. The latter is important due to the O(-) character of the wave function at the saddle point and products. Normal modes and vibrational energy levels are given for the reactants, saddle points and products. Finally, quantitative energetics are obtained by implementing a small CAS (complete active space) approach followed by limited configuration interaction (CI) calculations. Comparisons are made with available experimental data.

N87-26202\*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

NASA MARSHALL SPACE FLIGHT CENTER ATOMIC OXYGEN INVESTIGATIONS Abstract Only

In Jet Propulsion Lab., Proceedings of the NASA Workshop on
 Atomic Oxygen Effects p 166
 1 Jun. 1987
 Avail: NTIS HC A09/MF A01
 CSCL 07D

An overview of the MSFC atomic oxygen investigations is provided, including descriptions of flight studies, ground-based testing, contractual efforts, and future focus. Summary results of

flight experiments on STS-5, STS-8, and STS 41-G are presented. The development of the MSFC Atomic Oxygen Resistive Monitor for the upcoming EOIM-3 (Evaluation of Oxygen Interaction with Materials 3) flight experiment is reviewed. Materials characterization work and ground-based testing are described. Contractual efforts, such as the development of atomic oxygen resistant coatings for the space station, are discussed. Future emphasis is placed on ground-based testing via the development and operation of a state-of-the-art atomic oxygen simulation system and on the continuation of flight studies in support of multi-programs.

Author

N87-26203\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

AN EVALUATION OF CANDIDATE OXIDATION RESISTANT MATERIALS Abstract Only

SHARON RUTLEDGE, BRUCE BANKS, MICHAEL MIRTICH, FRANK DIFILIPPO, DEBORAH HOTES, RICHARD LABED, TERESE DEVER, and MICHAEL KUSSMAUL (Cleveland State Univ., Ohio.) *In* Jet Propulsion Lab., Proceedings of the NASA Workshop on Atomic Oxygen Effects p 167 1 Jun. 1987 Avail: NTIS HC A09/MF A01 CSCL 07D

Ground based testing of materials considered for Kapton solar array blanket protection, graphite epoxy structural member protection, and high temperature radiators was performed in an RF plasma asher. Ashing rates for Kapton were correlated with rates measured on STS-8 to determine the exposure time equivalent to one year in low Earth orbit (LEO) at a constant density space station orbital flux. Protective coatings on Kapton from Tekmat, Andus Corporation, and LeRC were evaluated in the plasma asher and mass loss rates per unit area were measured for each sample. All samples evaluated provided some protection to the underlying surface but ion beam sputter deposited samples of SiO2 and SiO2 with 8% polytetrafluoroethylene (PTFE) showed no evidence of degradation after 47 hours of exposure. Mica paint was evaluated as a protective coating for graphite epoxy structural members. Mica appears to be resistant to attack by atomic oxygen but only offers some limited protection as a paint because the paint vehicles evaluated to date were not resistant to atomic oxygen. Four materials were selected for evaluation as candidate radiator materials: stainless steel, copper, niobium-1% zirconium, and titanium-6% aluminum-4% vanadium. These materials were surface textured by various means to improve their emittance. Emittances as high as 0.93 at 2.5 microns for stainless steel and 0.89 at 2.5 microns for Nb-1 Zr were obtained from surface texturing. There were no significant changes in emittance after Author asher exposure.

## N87-26206\*# Boeing Aerospace Co., Seattle, Wash. COMMENTS ON THE INTERACTION OF MATERIALS WITH ATOMIC OXYGEN Abstract Only

LARRY P. TORRE and H. GARY PIPPIN In Jet Propulsion Lab., Proceedings of the NASA Workshop on Atomic Oxygen Effects p 170 1 Jun. 1987

Avail: NTIS HC A09/MF A01 CSCL 07D

An explanation of the relative resistance of various materials to attack by atomic oxygen is presented. Data from both ground based and on-orbit experiments is interpreted. The results indicate the importance of bond strengths, size and structure of pendant groups, and fluorination to the resistance of certain polymers to atomic oxygen. A theory which provides a partial explanation of the degradation of materials in low Earth orbit due to surface recombination of oxygen atoms is also included. Finally, a section commenting on mechanisms of material degradation is provided.

Author

N87-27809# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Chemistry.
AROMATIC POLYESTER POLYSILOXANE BLOCK
COPOLYMERS: MULTIPHASE TRANSPARENT DAMPING
MATERIALS Final Report, 1 May 1984 - 30 Apr. 1985
JAMES E. MCGRATH 2 Oct. 1986 341 p

(Contract AF-AFOSR-0201-83) (AD-A182623; AFOSR-87-0176TR) Avail: NTIS HC A15/MF A01 CSCL 11I

The synthesis and characterization of multiphase, transparent block copolymers that are potential candidates for passive damping applications in large space structures are described. Relatively high molecular weight polysiloxane-polyarylester block copolymers were prepared by two different synthetic routes. A solution technique was used to synthesize well-defined, perfectly alternating block copolymers by reacting a disfunctional hydroxyl-terminated polyarylester obligomer. A second approach involved the preparation of a segmented (or random) block copolymer by an interfacial, phase-transfer technique in which various polyarylester block lengths are formed during the copolymerization by reacting bisphenol-A, terephthaloyl chloride, and isophthaloyl chloride with a disfunctional aminopropyl-terminated siloxane block compositions (dimethyl, dimethyl-diphenyl, or dimethyl-trifluoro propylmethyl) were controlled. New siloxane-ester block copolymers were prepared and characterized. They are believed to be potentially useful materials for passive damping applications in the space environment. GRA

N87-28584# IIT Research Inst., Chicago, III.
SPACE STABLE THERMAL CONTROL COATINGS Final
Report, Sep. 1983 - Dec. 1986

R. J. MELL and Y. HARADA May 1987 177 p (Contract F33615-83-K-5099)

(AD-A182796; IITRI-M06124-F; AFWAL-TR-87-4010) Avail: NTIS HC A09/MF A01 CSCL 11C

An important aspect of satellite operation in a space environment is thermal control design. Various coatings having desired optical properties have been used to achieve passive thermal control of different spacecraft. IITRI's S13G/LO coating has found widespread use in a number of missions for 15 years. The source of binder material for S13G/LO, however, is now unavailable and there is a continuing need on various spacecraft missions for this type of coating. This report covers research to develop and qualify a material having the same or improved optical and physical properties as S13G/LO. The coating was to display desirable and reliable behavior in a space environment. The study has resulted in a material designated, S13G/LO-1, which exhibits properties as good as, or somewhat better than the original S13G/LO. Environment, Satellite Thermal Control, Radiation Effects, Material Outgassing, Silicone Resin.

N87-29709# Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.

## EFFECTS ON ADVANCED MATERIALS: RESULTS OF THE STS-8 EOIM (EFFECTS OF OXYGEN INTERACTION WITH MATERIALS) EXPERIMENT

M. J. MESHISHNEK, W. K. STUCKEY, J. S. EVANGELIDES, L. A. FELDMAN, and R. V. PETERSON 20 Jul. 1987 89 p (Contract F04701-85-C-0086)

(AD-A182931; TR-0086(6935-05)-2; SD-TR-87-34) Avail: NTIS HC A05/MF A01 CSCL 11D

A variety of materials were exposed to the low Earth orbit space environment on shuttle flight STS-8 as a part of NASA's Effects of Oxygen Atoms Interaction with Materials experiment. These materials include carbon and graphites, optical materials, organic and metal films, Kevlar and fiberglass fabric, and high-temperature coatings. The effects noted on these materials

included oxidative erosion of the carbon and graphite, loss of tensile strength for the Kevlar fabric, erosion and oxidation of organic films, partial oxidation of infrared optical materials, and loss of reflectance for the high-temperature coatings.

#### 12

#### **INFORMATION AND DATA MANAGEMENT**

Includes descriptions, requirements, and trade studies of different information and data system hardware and software, languages, architecture, processing and storage requirements for managing and monitoring of different systems and subsystems.

## A87-31463 HEAD-PORTED DISPLAY ANALYSIS FOR SPACE STATION APPLICATIONS

KATHLEEN RADKE, PAMELA JAMAR, and LEE LEVITAN (Honeywell Systems and Research Center, Minneapolis, MN) IN: Digital Avionics Systems Conference, 7th, Fort Worth, TX, Oct. 13-16, 1986, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 105-112.

This report describes the evaluation of the impact of using a head-ported display unit for Space Station activities. The technology survey identified applicable CRT and non-CRT display technologies suitable for a head-ported unit. A set of 14 crew task applications for head-ported displays was identified. A smaller set of high pay-off applications was then selected through analysis which included consideration for crew time spent in each activity, display requirements, visual, manual and verbal tasks performed while using the display, and the benefits a head-ported display would bring to the application compared to fixed or portable display configurations. Finally, the study evaluated the design impact that head-ported displays would have on the overall Space Station system.

## A87-31518 ON THE PERFORMANCE ANALYSIS OF A REAL-TIME DISTRIBUTED COMPUTER SYSTEM

RAMI S. MANGOUBI, ELIEZER GAI (Charles Stark Draper Laboratory, Inc., Cambridge, MA), and BRUCE K. WALKER (MIT, Cambridge, MA) IN: Digital Avionics Systems Conference, 7th, Fort Worth, TX, Oct. 13-16, 1986, Proceedings . New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 529-535.

This paper is a continuation of a previous study, (Mangoubi et al., 1985) on the performance analysis of a special purpose real-time distributed computer system. The system must perform specific tasks that are repetitive and have known cycle or deadline times. Such systems arise in aerospace applications, where specific tasks, such as the calculation of feedback control signals, must be processed within a certain time period. Two performance indices are appropriate for such a system: the task delay times and the device or system utilization. The performance analysis is based on a queueing theory methodology. In this paper, results for the standard deviation of the delay times are given. Design issues and queue disciplines affecting performance are also discussed, and numerical results using a Space Station application as an example are presented. The results include a comparison among various queue disciplines.

#### A87-32075 EXPERT SYSTEMS IN SPACE

DAVID LEINWEBER (Inference Corp., Los Angeles, CA) IEEE Expert (ISSN 0885-9000), vol. 2, Spring 1987, p. 26-36. refs

The requirements of expert systems for monitoring and real-time control of processes on space platforms and the Space Station are described, along with a prototype system. Emphasis is on process intelligent control (PICON) written in Lisp, giving the expert system the capability of taking care of problems while maintaining operational continuity. Design criteria include rapid focusing on relevant sensors, fast data collection during critical events, analysis of the temporal history of sensor values, discerning the causes of anomalies from their effects through knowledge of the underlying process structure, and amenability to command sequence inputs. Techniques for using PICON to develop expert systems for specific roles and with the capability of interacting with other systems, for

knowledge engineering, and to imbue the system with the ability to reason about data quality are explored. A sample application, control of the electrical power system for the Space Station, is outlined.

M.S.K.

#### A87-33040

### AN EVALUATION OF MENU SYSTEMS FOR SPACE STATION INTERFACES

JONATHAN F. ANTIN (Virginia Polytechnic Institute and State University, Blacksburg) IN: Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volume 1 . Santa Monica, CA, Human Factors Society, 1986, p. 679-683. refs

Menu systems are considered in terms of their ability to meet proposed basic requirements for Space Station interfaces. The following command modes are evaluated: (1) the direct mode, in which all commands are typed on a QWERTY keyboard (2) the menu mode, and (3) the hybrid mode which presented the same menus as were displayed in the menu mode, but commands could be selected from the menu via cursor control or typed in directly. It is concluded that the menu selection dialogue may be a useful and even preferred interactive environment for all levels of users; however, it must be well designed and flexible enough to meet their many needs.

#### A87-35282

COMPUTERIZED AEROSPACE MATERIALS DATA; PROCEEDINGS OF THE WORKSHOP ON COMPUTERIZED PROPERTY MATERIALS AND DESIGN DATA FOR THE AEROSPACE INDUSTRY, EL SEGUNDO, CA, JUNE 23-25, 1986 JACK H. WESTBROOK, ED. (Sci-Tech Knowledge Systems, Scotia, NY) and LOUIS R. MCCREIGHT, ED. (Aerospace Corp., El Segundo, CA) Workshop sponsored by the Aerospace Corp., Strategic Defense Initiative Organization, AIAA, et al. New York, American Institute of Aeronautics and Astronautics, Inc., 1987, 213 p. For individual items see A87-35283 to A87-35285.

Recommendations and guidelines are presented for the development of The National Materials Property Data Network. The underlying motivations for extablishing the Network are delineated, particularly its necessity for maintaining the competitiveness of U.S. industries. Providing on-line access to published technical documentation and research data, the Network subject matter will cover the physical, mechanical, corrosion and chemical properties of materials from indigenous and worldwise sources. The coverage will eventually extend to the optical and electrical properties of materials, along with access to hardcopy information. Information on metals, composites, polymers, structural materials for microapplications, ceramics and adhesives is to be available. Plans for the access procedures and the use interface are explored. Consideration is also given to applying CAD capabilities for integrated life-cycle planning during the design M.S.K.

A87-37293\*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. SPACE STATION DATA MANAGEMENT SYSTEM

**ARCHITECTURE** 

WILLIAM E. MALLARY and VIRGINIA A. WHITELAW (NASA, Johnson Space Center, Houston, TX) IEEE, Proceedings (ISSN 0018-9219), vol. 75, March 1987, p. 320-328.

Within the Space Station program, the Data Management System (DMS) functions in a dual role. First, it provides the hardware resources and software services which support the data processing, data communications, and data storage functions of the onboard subsystems and payloads. Second, it functions as an integrating entity which provides a common operating environment and human-machine interface for the operation and control of the orbiting Space Station systems and payloads by both the crew and the ground operators. This paper discusses the evolution and derivation of the requirements and issues which have had significant effect on the design of the Space Station DMS, describes the DMS components and services which support system and payload operations, and presents the current architectural view of the

system as it exists in October 1986; one-and-a-half years into the Space Station Phase B Definition and Preliminary Design Study.

National Aeronautics and Space Administration. A87-37294\*# Lyndon B. Johnson Space Center, Houston, Tex.

#### SPACE STATION DATA MANAGEMENT SYSTEM - A COMMON GSE TEST INTERFACE FOR SYSTEMS TESTING AND VERIFICATION

PEDRO A. MARTINEZ and KEVIN W. DUNN (NASA, Johnson Space Center, Houston, TX) IEEE, Proceedings (ISSN 0018-9219). vol. 75, March 1987, p. 329-335. refs

This paper examines the fundamental problems and goals associated with test, verification, and flight-certification of man-rated distributed data systems. First, a summary of the characteristics of modern computer systems that affect the testing process is provided. Then, verification requirements are expressed in terms of an overall test philosophy for distributed computer systems. This test philosophy stems from previous experience that was gained with centralized systems (Apollo and the Space Shuttle), and deals directly with the new problems that verification of distributed systems may present. Finally, a description of potential hardware and software tools to help solve these problems is Author provided.

#### A87-37431 STAR TOPOLOGY SPACECRAFT DATA BUS

ANTHONY G. GARAS (Sperry Corp., Space Systems Div., Glendale, AZ) IN: ITC/USA/'86; Proceedings of the International Telemetering Conference, Las Vegas, NV, Oct. 13-16, 1986 Research Triangle Park, NC, Instrument Society of America, 1986, p. 727-736.

The projected NASA Space Station and SDI platforms will require distributed processing and real time control whose data communication networks' bus data rates will be of the order of 100-500 MBPS. A novel communications protocol is presented which furnishes a high data rate and very short transport delay performance; its implementation by means of a star topology fiber optic data bus has given attention to system robustness, redundancy, fault tolerance, autonomy, and error control. The performance of an eight-node demonstration network is O.C. assessed.

#### A87-37968\* Bell Telephone Labs., Inc., Murray Hill, N. J. A CRISIS IN THE NASA SPACE AND EARTH SCIENCES **PROGRAMME**

LOUIS LANZEROTTI, J. (AT&T Bell Telephone Laboratories, Murray Hill, NJ), JEFFREY D. ROSENDHAL, DAVID C. BLACK (NASA, Washington, DC), D. JAMES BAKER (Joint Oceoanographic Institutions, Inc., Washington, DC), PETER M. BANKS (Stanford University, CA), FRANCIS BRETHERTON (National Center for Atmospheric Research, Boulder, CO), ROBERT A. BROWN (Space Telescope Science Institute, Baltimore, MD), KEVIN C. BURKE (Lunar and Planetary Institute, Houston, TX), JOSEPH A. BURNS (Cornell University, Ithaca, NY), CLAUDE R. CANIZARES (MIT, Space Policy (ISSN 0265-9646), vol. 3, Cambridge, MA) et al. Feb. 1987, p. 38-51.

Problems in the space and earth science programs are examined. Changes in the research environment and requirements for the space and earth sciences, for example from small Explorer missions to multispacecraft missions, have been observed. The need to expand the computational capabilities for space and earth sciences is discussed. The effects of fluctuations in funding. program delays, the limited number of space flights, and the development of the Space Station on research in the areas of astronomy and astrophysics, planetary exploration, solar and space physics, and earth science are analyzed. The recommendations of the Space and Earth Science Advisory Committee on the development and maintenance of effective space and earth sciences programs are described.

#### A87-40358

#### AN OPERATIONS MANAGEMENT SYSTEM FOR THE SPACE STATION

TERRY R. SAVAGE (TRW, Inc., Redondo Beach, CA) EASCON '86; Proceedings of the Nineteenth Annual Electronics and Aerospace Systems Conference, Washington, DC, Sept. 8-10, 1986 . New York, Institute of Electrical and Electronics Engineers. Inc., 1986, p. 60-64. refs

A description is provided of an Operations Management System (OMS) for the planned NASA Space Station. The OMS would be distributed both in space and on the ground, and provide a transparent interface to the communications and data processing facilities of the Space Station Program. The allocation of OMS responsibilities has, in the most current Space Station design, been fragmented among the Communications and Tracking Subsystem (CTS), the Data Management System (DMS), and a redefined OMS. In this current view, OMS is less of a participant in the real-time processing, and more an overseer of the health and management of the Space Station operations.

#### A87-40359

#### COMMUNICATION AND DATA MANAGEMENT SYSTEMS FOR AN ORBITING PLATFORM

WALTON CLARK (TRW, Inc., Cleveland, OH) and HOWARD KRAIMAN (General Electric Co., Fairfield, CT) IN: EASCON '86; Proceedings of the Nineteenth Annual Electronics and Aerospace Systems Conference, Washington, DC, Sept. 8-10, 1986 . New York, Institute of Electrical and Electronics Engineers. Inc., 1986. p. 65-71. refs

The Data Management System (DMS) provides the following services to an orbiting platform: (1) data distribution within and between core systems and payloads, (2) data processing facilities for core systems, (3) data base management, (4) time and frequency standards, and (5) overall platform management and control. The DMS is a distributed data processing network. The nodes are connected by a local area network. Each node is autonomous. Since the design is modular, nodes can be added or deleted without disturbing the system. Sensors and effectors communicate with the core system software via the network through multiplexers/demultiplexers.

#### A87-40381 ON BOARD DATA MANAGEMENT

PAUL D. LILES and EDWARD V. DONG (Rockwell International Corp., Space Station Systems Div., Downey, CA) IN: EASCON '86; Proceedings of the Nineteenth Annual Electronics and Aerospace Systems Conference, Washington, DC, Sept. 8-10, 1986 New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 270-275.

The Space Station is the next step in the U.S. space program. A key element of the Space Station is the on-board Data Management System (DMS). The DMS must provide a processing environment like that of a commercial or scientific ground computer system, but also support Station operations and missions like any airborne real-time avionics. At the same time, the DMS must be designed for growth and evolution. The fundamental architecture and functions of the DMS, however, have been defined. A brief overview is herein presented, based on current NASA concepts. Author

National Aeronautics and Space Administration. A87-42821\* Ames Research Center, Moffett Field, Calif.

#### PROOF THAT TIMING REQUIREMENTS OF THE FDDI TOKEN RING PROTOCOL ARE SATISFIED

MARJORY J. JOHNSON (NASA, Ames Research Center, Moffett IEEE Transactions on Communications (ISSN 0090-6778), vol. COM-35, June 1987, p. 620-625. refs (Contract NAS2-11530)

The fiber distributed data interface (FDDI) is an ANSI draft proposed standard for a 100 Mbit/s fiber-optic token ring. The FDDI timed token access protocol provides dynamic adjustment of the load offered to the ring, with the goal of maintaining a specified token rotation time and of providing a guaranteed upper

bound on time between successive arrivals of the token at a station. FDDI also provides automatic recovery when errors occur. The bound on time between successive token arrivals is guaranteed only if the token rotates quickly enough to satisfy timer requirements in each station when all ring resources are functioning properly. Otherwise, recovery would be initiated unnecessarily. The purpose of this paper is to prove that FDDI timing requirements are satisfied. i.e., the token rotates quickly enough to prevent initiation of recovery unless there is failure of a physical resource or unless the network management entity within a station initiates the recovery process.

A87-45485\* LinCom Corp., Los Angeles, Calif. FEASIBILITY STUDY ON 8PSK, QPSK, TFM, BY USING CLASS FOR SPACE STATION/TDRSS REAL MEASURED CHANNEL

SONG H. AN (LinCom Corp., Los Angeles, CA) and ROBERT D. GODFREY (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: GLOBECOM '86 - Global Telecommunications Conference, Houston, TX, Dec. 1-4, 1986, Conference Record. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 150-154, refs

(Contract NAS5-29124)

The feasibility of transmitting 500 Mbps data rate through the TDRSS real channel (about 2.5 bits/sec/Hz) for the Space Station application is studied in this paper. The modulation schemes examined are octal phase shift keying, quarternary phase shift keying, and tamed frequency modulation scheme. The software tool used is the Communication Link Analysis and Simulation System. A channel equalizer is shown to be required for such application. Sensitivity results, eye diagrams, and phase trajectory diagrams are presented for discussions.

#### A87-45521

#### A COST EFFECTIVE 300 MBPS SPACE-TO-GROUND COMMUNICATIONS SUBSYSTEM FOR THE SPACE STATION

PAUL R. JORDAN and PETER W. NILSEN (TRW, Inc., TRW Electronic Systems Group, Redondo Beach, CA) IN: GLOBECOM '86 - Global Telecommunications Conference, Houston, TX, Dec. 1-4, 1986, Conference Record. Volume 2 . New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 826-831.

The design of a 300 Mbps space-to-ground communications subsystem (SGCS) for the Space Station is described. The SGCS is to provide forward link command and control channels between the ground, platforms, and Space Station, and the audio and video channels to the Space Station. The tracking and data relay satellite system is the main element for space-to-ground data flow; the is based on a Ku-band/X-band wideband data SGCS communication system. The data link requirements for the Space Station and its platforms are defined, and the development of cost-effective antennas for the Space Station and platforms is discussed. The components and capabilities of the RF and signal and data processing equipment of the SGCS are examined.

Diagrams of the SGCS are presented.

I.F.

#### A87-48583#

#### PROCESS CONTROL AND DATA ACQUISITION FOR COMMERCIAL MATERIALS PROCESSING IN SPACE

EARL L. COOK (3M Co., Space Research and Applications Laboratory, Saint Paul, MN) AIAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 7 p. (AIAA PAPER 87-2197)

Process control and data acquisition requirements for the research, development, and manufacturing phases of materials processing in space are examined. It is determined that it is necessary for the data system to be hierarchical and distributed with well-defined interfaces between the various hierarchical levels, flexible, and capable of quick reprogramming and restructuring of experiments and acquiring and storing large amounts of data. A prototype system for the multiple secondary payloads on the Shuttle, the Payload Support Network (PSN), which allows simultaneous control of and operational interaction with multiple

payloads connected in a network is proposed. The functions of the three major subsystems of the PSN, the crew interface, dedicated experiment processors, and an interconnection network, are described.

A87-48587\*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

#### DATA STORAGE SYSTEMS TECHNOLOGY FOR THE SPACE STATION ERA

JOHN DALTON, FRED MCCALEB, JOHN SOS, JAMES CHESNEY. DAVID HOWELL (NASA, Goddard Space Flight Center, Greenbelt, MD) et al. AIAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 8 p. (AIAA PAPER 87-2202)

The paper presents the results of an internal NASA study to determine if economically feasible data storage solutions are likely to be available to support the ground data transport segment of the Space Station mission. An internal NASA effort to prototype a portion of the required ground data processing system is outlined. It is concluded that the requirements for all ground data storage functions can be met with commercial disk and tape drives assuming conservative technology improvements and that, to meet Space Station data rates with commercial technology, the data will have to be distributed over multiple devices operating in parallel and in a sustained maximum throughput mode.

National Aeronautics and Space Administration. A87-48588\*# Goddard Space Flight Center, Greenbelt, Md.

DATA CAPTURE AND PROCESSING

JOHN LYON, GENE SMITH, and RICHARD CARPER (NASA, Goddard Space Flight Center, Greenbelt, MD) AIAA and NASA. International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 14 p.

(AIAA PAPER 87-2203)

A systems concept developed in response to the specific requirements imposed by the Space Station and affiliated instrumentation is described. Particular attention is given to those subsystems associated with initial data capture, handling, routing, and distribution control for return link data via the Tracking and Data Relay Satellite System. The conceived approach, designated the Customer Data and Operations System, includes a data interface facility and a data handling center whose functions are data capture, demultiplexing and routing, early preprocessing, and ancillary data handling.

**A87-48589\***# Washington, D.C. National Aeronautics and Space Administration,

#### THE CONSULTATIVE COMMITTEE FOR SPACE DATA SYSTEMS STANDARDS PROGRAM

S. RICHARD COSTA (NASA, Washington, DC) AIAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 8 p.

(AIAA PAPER 87-2204)

The objectives of the Consultative Committee for Space Data Systems (CCSDS) include the identification of those common elements of space data systems which, if implemented in a standardized way, will significantly enhance the operation of future cooperative space missions. Recommendations of the CCSDS include packet telemetry and telecommand concepts, coding designs, ancillary data parameters and formats, and data exchange conventions. Consideration is given to the application of CCSDS recommendations. K.K.

#### A87-48590#

#### DATA MANAGEMENT STANDARDS FOR SPACE **INFORMATION SYSTEMS**

R. DES JARDINS (Computer Technology Associates, Inc., McLean, VA) and C. MAZZA (ESA, European Space Operations Centre, Darmstadt, West Germany) AIAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 7 p. (AIAA PAPER 87-2205)

Data management - that is, storing, describing and retrieving data - is a special problem for the high performance bit-efficient information systems required for space missions. This paper presents a summary description of data management for space information systems, and describes four specific problem areas that can benefit from data management standards in the Space Station era: data description, data capture, data interchange, and data interpretation. In each area, a recommended modern data management standard or related technique is described as an example recommendation for future space information systems. The paper concludes with a recommendation that space agencies develop testbed validations of these 'new' approaches to data management.

**A87-48593\*#** National Aeronautics and Space Administration, Washington, D.C.

### THE SPACE STATION SOFTWARE SUPPORT ENVIRONMENT - NOT JUST WHAT, BUT WHY

JOHN R. GARMAN (NASA, Space Station Program Office, Washington, DC) AlAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 9 p. refs (AlAA PAPER 87-2208)

The NASA environment is described with attention given to mission data systems in NASA and the strategic view. Space Station data systems are characterized into the following: distributed data systems, functionality and complexity, session oriented user interface, and distributed software development. The concept of a support software environment within the Space Station Program is elucidated and a strategic model for integrated data processing is presented.

**A87-48600\***# National Aeronautics and Space Administration, Washington, D.C.

### TECHNICAL AND MANAGEMENT INFORMATION SYSTEM

TIMOTHY R. RAU (NASA, Washington, DC) AIAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 10 p. (AIAA PAPER 87-2217)

The TMIS goals developed to support the Space Station Program (SSP) mission requirements are outlined. The TMIS will provide common capabilities to all SSP centers and facilitate the flow of technical and management information throughout the program as well as SSP decision-making processes. A summary is presented of the various TMIS phases.

K.K.

A87-48606\*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

### SPACE STATION INFORMATION SYSTEM INTEGRATED COMMUNICATIONS CONCEPT

J. MURATORE, J. BIGHAM, V. WHITELAW, and W. MARKER (NASA, Johnson Space Center, Houston, TX) AIAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 7 p. (AIAA PAPER 87-2228)

This paper presents a model for integrated communications within the Space Station Information System (SSIS). The SSIS is generally defined as the integrated set of space and ground information systems and networks which will provide required data services to the Space Station flight crew, ground operations personnel, and customer communities. This model is based on the International Standards Organization (ISO) layered model for Open Systems Interconnection (OSI). The requirements used to develop the model are presented, and the various elements of the model described.

A87-48607\*# National Aeronautics and Space Administration.
Lyndon B. Johnson Space Center, Houston, Tex.

SPACE STATION INFORMATION SYSTEM REQUIREMENTS

### SPACE STATION INFORMATION SYSTEM REQUIREMENTS FOR INTEGRATED COMMUNICATIONS

W. MARKER (NASA, Johnson Space Center, Houston, TX), V. WHITELAW, J. MURATORE, and J. BIGHAM, JR. AIAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 5 p. (AIAA PAPER 87-2229)

Space Station Information System (SSIS) requirements for integrated end-to-end communications are presented. The SSIS is defined as the integrated set of space and ground data and information systems and networks which will provide required data services to the Space Station flight crew, ground operations personnel, and customer communities. This model is based on the International Standards Organization (ISO) layered model for Open System Interconnection (OSI). These SSIS requirements include grades of service, priority classifications, systems management, flow control, bandwidth allocation, and standard SSIS data services.

# N87-20630# European Space Agency. ESRIN, Frascati (Italy). PAYLOAD DATA MANAGEMENT SCHEME PLANNED FOR EARTH OBSERVATION SENSORS TO BE FLOWN ON THE POLAR PLATFORMS IN THE FRAMEWORK OF THE SPACE STATION/COLUMBUS PROGRAM

L. MARELLI *In its* Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-sensing (ESPOIR) p 55-61 Nov. 1986

Avail: NTIS HC A07/MF A01

Data transmission to the ground from the Columbus polar platform; data acquisition and recording; data processing and dissemination; data archive/retrieval; and user interfaces are discussed.

## N87-20639# European Space Agency. ESRIN, Frascati (Italy). DATA MANAGEMENT PANEL REPORT

L. MARELLI *In its* Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-sensing (ESPOIR) p 101-102 Nov. 1986

Avail: NTIS HC A07/MF A01

Data gathering, data processing and dissemination, data archiving and retrieval, and user support services for the Columbus space station polar platforms are discussed.

N87-23161\*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

#### SOT: A RAPID PROTOTYPE USING TAE WINDOWS

MARK STEPHENS, DAVID EIKE, ELFRIEDA HARRIS (Science Applications Research, Lanham, Md.), and DANA MILLER In its Sixth Annual Users' Conference p 97-110 Oct. 1986

Avail: NTIS HC A11/MF A01 CSCL 09B

The development of the window interface extension feature of the Transportable Applications Executive (TAE) is discussed. This feature is being used to prototype a space station payload interface in order to demonstrate and assess the benefits of using windows on a bit mapped display and also to convey the concept of telescience, the control and operation of space station payloads from remote sites. The prototype version of the TAE with windows operates on a DEC VAXstation 100. This workstation has a high resolution 19 inch bit mapped display, a keyboard and a three-button mouse. The VAXstation 100 is not a stand-alone workstation, but is controlled by software executing on a VAX/8600. A short scenario was developed utilizing the Solar Optical Telescope (SOT) as an example payload. In the scenario the end-user station includes the VAXstation 100 plus an image analysis terminal used to display the CCD images. The layout and use of the prototype elements, i.e., the root menu, payload status window, and target acquisition menu is described.

N87-24817\*# California Univ., Santa Barbara. Information Sciences Research Group.

REMOTE SENSING INFORMATION SCIENCES RESEARCH GROUP: SANTA BARBARA INFORMATION SCIENCES RESEARCH GROUP, YEAR 4 Final Report

JOHN E. ESTES, TERENCE SMITH, and JEFFREY L. STAR 1 Jun. 1987 17 p

(Contract NAGW-455)

(NASA-CR-181073; NAS 1.26:181073) Avail: NTIS HC A02/MF A01 CSCL 05B

Information Sciences Research Group (ISRG) research continues to focus on improving the type, quantity, and quality of information which can be derived from remotely sensed data. Particular focus in on the needs of the remote sensing research and application science community which will be served by the Earth Observing System (EOS) and Space Station, including associated polar and co-orbiting platforms. The areas of georeferenced information systems, machine assisted information extraction from image data, artificial intelligence and both natural and cultural vegetation analysis and modeling research will be expanded.

N87-25890\*# Stevens Inst. of Tech., Hoboken, N.J. Dept. of Electrical Engineering and Computer Science.

## INTEGRATION OF COMMUNICATIONS AND TRACKING DATA PROCESSING SIMULATION FOR SPACE STATION

ROBERT C. LACOVARA In NASA. Lyndon B. Johnson Space Center, National Aeronautics and Space Administration (NASA)/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1986, Volume 2 11 p Jun. 1987

Avail: NTIS HC A13/MF A01 CSCL 17B

A simplified model of the communications network for the Communications and Tracking Data Processing System (CTDP) was developed. It was simulated by use of programs running on several on-site computers. These programs communicate with one another by means of both local area networks and direct serial connections. The domain of the model and its simulation is from Orbital Replaceable Unit (ORU) interface to Data Management Systems (DMS). The simulation was designed to allow status queries from remote entities across the DMS networks to be propagated through the model to several simulated ORU's. The ORU response is then propagated back to the remote entity which originated the request. Response times at the various levels were investigated in a multi-tasking, multi-user operating system environment. Results indicate that the effective bandwidth of the system may be too low to support expected data volume requirements under conventional operating systems. Instead, some form of embedded process control program may be required on the node computers.

# N87-26057# Electronique Serge Dassault, St. Cloud (France). STUDY OF EXPERT SYSTEM APPLICATIONS TO SPACE PROJECTS Final Report [ETUDE DE L'APPLICATION DES SYSTEMES EXPERTS AUX PROJETS SPATIAUX]

M. GUERIN Paris, France ESA 15 Jan. 1986 62 p In

(Contract ESTEC-6028/84-NL-JS)

(NE-51-867; ESA-CR(P)-2316; ETN-87-99872) Avail: NTIS HC A04/MF A01

The applicability of artificial intelligence and expert systems to space projects is discussed and the potential utilization areas are identified, including thermal analysis, electric systems, optical systems, planning, design data bases, image processing, satellite control, orbit computations, launchers, space station diagnostics, maintenance, and project management.

# N87-26698\*# City Univ. of New York, Bronx. Dept. of Physics. DEVELOPMENT OF A COMPUTER PROGRAM TO GENERATE TYPICAL MEASUREMENT VALUES FOR VARIOUS SYSTEMS ON A SPACE STATION

LOUIS A. DEACETIS In NASA. Lyndon B. Johnson Space Center, National Aeronautics and Space Administration (NASA)/American

Society for Engineering Education (ASEE) Summer Faculty Fellowship Program, 1986, Volume 1 7 p Jun. 1987 Avail: NTIS HC A16/MF A01 CSCL 05A

The elements of a simulation program written in Ada were developed. The program will eventually serve as a data generator of typical readings from various space station equipment involved with Communications and Tracking, and will simulate various scenarios that may arise due to equipment malfunction or failure, power failure, etc. In addition, an evaluation of the Ada language was made from the viewpoint of a FORTRAN programmer learning Ada for the first time. Various strengths and difficulties associated with the learning and use of Ada are considered.

Author

N87-27443\*# National Aeronautics and Space Administration.
Goddard Space Flight Center, Greenbelt, Md.
MASS STORAGE SYSTEMS FOR DATA TRANSPORT IN THE

EARLY SPACE STATION ERA 1992-1998

RICHARD CARPER, ed., JOHN DALTON, ed., MIKE HEALEY, ed., LINDA KEMPSTER, ed., JOHN MARTIN, ed. (Computer Technology Associates, Inc., Lanham, Md.), FRED MCCALEB, ed., STANLEY SOBIESKI, ed., and JOHN SOS, ed. July 1987 112 p (NASA-TM-87826; REPT-87B0343; NAS 1.15:87826) Avail: NTIS HC A06/MF A01 CSCL 09B

NASA's Space Station Program will provide a vehicle to deploy an unprecedented number of data producing experiments and operational devices. Peak down link data rates are expected to be in the 500 megabit per second range and the daily data volume could reach 2.4 terabytes. Such startling requirements inspired an internal NASA study to determine if economically viable data storage solutions are likely to be available to support the Ground Data Transport segment of the NASA data system. To derive the requirements for data storage subsystems, several alternative data transport architectures were identified with different degrees of decentralization. Data storage operations at each subsystem were categorized based on access time and retrieval functions, and reduced to the following types of subsystems: First in First out (FIFO) storage, fast random access storage, and slow access with staging. The study showed that industry funded magnetic and optical storage technology has a reasonable probability of meeting these requirements. There are, however, system level issues that need to be addressed in the near term.

N87-28585# Selenia S.p.A., Rome (Italy).
DATA MANAGEMENT SYSTEM ARCHITECTURE OPTIONS
FOR SPACE STATIONS Final Report

S. BOESSO, R. GAMBERALE, C. MONACO, L. HEFNER, and K. PEDERSEN Paris, France ESA 22 May 1987 460 p (Contract ESTEC-5997/84-NL-PP(SC))

(SES/DNP/TR/002/85; ESA-CR(P)-2362; ETN-87-90466) Avail: NTIS HC A20/MF A01

The Columbus space station information system onboard function and requirements are summarized. Space Station Data Management (SSDMS) requirements (steady state and mission dependent) are given with quantification based on reference studies. Design and technology options concerning architecture, software, and SSDMS elements are presented and traded-off. A baseline for the initial SSDMS configuration is described and the growth capability is shown; diagnostic approach and validation and test concepts are discussed. Cost factors and critical elements of the SSDMS solution are defined; a program schedule and the required resources for study contracts to support development of the proposed configuration are outlined.

N87-28586# MATRA Espace, Paris-Velizy (France).
STUDY OF DATA MANAGEMENT SYSTEM ARCHITECTURE
OPTIONS FOR SPACE STATION Final Report

Paris, France ESA 18 Oct. 1985 227 p Prepared in cooperation with Messerschmitt Boelkow Blohm/Entwicklungspring Nord, Bremen, West Germany

(Contract ESTEC-5996/84-NL-PP(SC))

(MATRA-RF/176/0932-ISS-1; ESA-CR(P)-2363; ETN-87-90467)

Avail: NTIS HC A11/MF A01

An approach to the Columbus space station which considers the Space Station Data Management System (SS-DMS) as a federation of local area DMS, interconnected through a wide area network is proposed. The European pressurized module DMS appears as one of the local area DMS, having well identified interfaces with the other local areas. The role of the gateway node in the coordination tasks between a local area and the remaining part of the space station is shown. The proposed local area architecture is compatible with the four Columbus elements, and the same type of LAN can be used in all four elements. An approach for scheduling the space station resource sharing is proposed, including a direct access concept. The production of quick looks on payload data is discussed. It is proposed to model the DMS with four types of functions: mission management, monitoring and reconfiguration, services, and resources. The fact that the resources and services are spread over the module causes the introduction of a distributed architecture concept.

N87-29124\*# National Aeronautics and Space Administration, Washington, D.C.

PROCEEDINGS: COMPUTER SCIENCE AND DATA SYSTEMS TECHNICAL SYMPOSIUM, VOLUME 1

RONALD L. LARSEN and KENNETH WALLGREN Aug. 198 353 p Symposium held in Leesburg, Va., 16-18 Apr. 1985 (NASA-TM-89285; NAS 1.15:89285) Avail: NTIS HC A16/MF A01 CSCL 09B

Progress reports and technical updates of programs being performed by NASA centers are covered. Presentations in viewgraph form are included for topics in three categories: computer science, data systems and space station applications.

N87-29127\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

DISTRIBUTED COMPUTER TAXONOMY BASED ON O/S STRUCTURE

EDWIN C. FOUDRIAT In NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, Volume 1 10 p Aug. 1985

Avail: NTIS HC A16/MF A01 CSCL 09B

The taxonomy considers the resource structure at the operating system level. It compares a communication based taxonomy with the new taxonomy to illustrate how the latter does a better job when related to the client's view of the distributed computer. The results illustrate the fundamental features and what is required to construct fully distributed processing systems. The problem of using network computers on the space station is addressed. A detailed discussion of the taxonomy is not given here. Information is given in the form of charts and diagrams that were used to illustrate a talk.

N87-29128\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

### A WORKSTATION ENVIRONMENT FOR SOFTWARE ENGINEERING

SUSAN J. VOIGT In NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, Volume 1 11 p Aug. 1985

Avail: NTIS HC A16/MF A01 CSCL 09B

Information on a workstation environment for software engineering is given in outline form. Tools that help software engineers, elements of the present system, and future plans are noted.

R.J.F.

N87-29144\*# National Aeronautics and Space Administration, Washington, D.C.

PROCEEDINGS: COMPUTER SCIENCE AND DATA SYSTEMS TECHNICAL SYMPOSIUM, VOLUME 2

RONALD L. LARSEN and KENNETH WALLGREN Aug. 1985 381 p Symposium held in Leesburg, Va., 16-18 Apr. 1985 (NASA-TM-89286; NAS 1.15:89286) Avail: NTIS HC A17/MF A01 CSCL 09B

Progress reports and technical updates of programs being performed by NASA centers are covered. Presentations in

viewgraph form, along with abstracts, are included for topics in three catagories: computer science, data systems, and space station applications.

N87-29145\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

A VHSIC GENERAL PURPOSE PROCESSOR

H. F. BENZ In NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, Volume 2 20 p Aug. 1985

Avail: NTIS HC A17/MF A01 CSCL 09B

The very high speed integrated circuit (VHSIC) program offers NASA and its contractors assured availability of military specification embedded computer components and integrated computer aided design/computer aided engineering and software development support that result in low system life costs for data management systems on the space station and the Earth Observatory Satellite. Viewgraphs given review progress in both the Department of Defense VHSIC program and the NASA VHSIC related insertion development of a general purpose processor are presented.

N87-29146\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

#### MAX: A SPACE STATION COMPUTER OPTION

D. B. SMITH and R. D. RASMUSSEN In NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, Volume 2 12 p Aug. 1985
Avail: NTIS HC A17/MF A01 CSCL 09B

Information on Max, a space station computer option, is given in viewgraph form. The computer option is characterized by embedded, real-time applications; synchronous, cyclic operation and asynchronous, event driven operation; computationally intensive and data intensive processing; a wide range of throughput and memory requirements; a range of fault tolerant requirements from none to full; and maintainability, including capability for on-line substitution in critical systems.

R.J.F.

N87-29148\*# Jet Propulsion Lab., California Inst. of Tech.,

#### **FLIGHT ARRAY PROCESSOR**

In NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, Volume 2 10 p Aug. 1985 Avail: NTIS HC A17/MF A01 CSCL 09B

Spaceflight applications for the NASA Scatterometer (NSCAT), an ocean surface wind measuring system flown as part of the Navy Remote Ocean Sensing System (NROSS) are discussed in outline form, along with information on the Advanced Digital Synthetic aperture radar Processor (ADSP) that is being developed for ground-based processing of spacecraft Earth observations. Design considerations are listed. A block diagram of the scatterometer is given.

N87-29149\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

#### INFORMATION NETWORK ARCHITECTURES

N. D. MURRAY In NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, Volume 2 25 p Aug. 1985

Avail: NTIS HC A17/MF A01 CSCL 09B

Graphs, charts, diagrams and outlines of information relative to information network architectures for advanced aerospace missions, such as the Space Station, are presented. Local area information networks are considered a likely technology solution. The principle needs for the network are listed.

N87-29150\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

VIDEO IMAGE PROCESSING

N. D. MURRAY In NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, Volume 2 25 p Aug. 1985

Avail: NTIS HC A17/MF A01 CSCL 09B

Current technology projections indicate a lack of availability of special purpose computing for Space Station applications. Potential functions for video image special purpose processing are being investigated, such as smoothing, enhancement, restoration and filtering, data compression, feature extraction, object detection and identification, pixel interpolation/extrapolation, spectral estimation and factorization, and vision synthesis. Also, architectural approaches are being identified and a conceptual design generated. Computationally simple algorithms will be research and their image/vision effectiveness determined. Suitable algorithms will be implimented into an overall architectural approach that will provide image/vision processing at video rates that are flexible, selectable, and programmable. Information is given in the form of charts, diagrams and outlines.

N87-29151\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

FIBER OPTICS WAVELENGTH DIVISION MULTIPLEXING(COMPONENTS)

HERBERT D. HENDRICKS In NASA, Washington, Proceedings: Computer Science and Data Systems Technical symposium, Volume 2 13 p. Aug. 1985

Avail: NTIS HC A17/MF A01 CSCL 20F

The long term objectives are to develop optical multiplexers/demultiplexers, different wavelength and modulation stable semiconductor lasers and high data rate transceivers, as well as to test and evaluate fiber optic networks applicable to the Space Station. Progress in each of the above areas is briefly discussed.

Author

N87-29152\*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

FIBER OPTIC DATA SYSTEMS

R. HARTENSTEIN *In* NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, Volume 2 11 p Aug. 1985

Avail: NTIS HC A17/MF A01 CSCL 20F

An overview is given of a continuing data system architecture development effort. Accomplishments and states of Office of Aeronautics and Space Technology, NASA efforts are discussed, and possible future directions are briefly commented upon. Some performance data is presented on the access protocol utilized in the Bus Interface Unit (BIU) design effort, and it is compared with other access protocols. The status of the qualification effort is presented showing the successful qualification testing of cables, connectors, light emitting diodes and PIN diodes. Information is given in the form of charts and diagrams.

N87-29153\*# National Aeronautics and Space Administration, Washington, D.C.

ADVANCED LOCAL AREA NETWORK CONCEPTS

TERRY GRANT In NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, Volume 2 20 p Aug. 1985

Avail: NTIS HC A17/MF A01 CSCL 09B

Development of a good model of the data traffic requirements for Local Area Networks (LANs) onboard the Space Station is the driving problem in this work. A parameterized workload model is under development. An analysis contract has been started specifically to capture the distributed processing requirements for the Space Station and then to develop a top level model to simulate how various processing scenarios can handle the workload and what data communication patterns result. A summary of the Local Area Network Extendsible Simulator 2 Requirements Specification and excerpts from a grant report on the topological design of fiber optic local area networks with application to Expressnet are given.

N87-29157\*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**NETWORK RELIABILITY** 

MARJORY J. JOHNSON In NASA, Washington, Proceedings:

Computer Science and Data Systems Technical Symposium, Volume 2 20 p Aug. 1985

Avail: NTIS HC A17/MF A01 CSCL 09B

Network control (or network management) functions are essential for efficient and reliable operation of a network. Some control functions are currently included as part of the Open System Interconnection model. For local area networks, it is widely recognized that there is a need for additional control functions, including fault isolation functions, monitoring functions, and configuration functions. These functions can be implemented in either a central or distributed manner. The Fiber Distributed Data Interface Medium Access Control and Station Management protocols provide an example of distributed implementation. Relative information is presented here in outline form.

N87-29160\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

FIBER OPTICS COMMON TRANSCEIVER MODULE

HERBERT D. HENDRICKS *In* NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, Volume 2 7 p Aug. 1985

Avail: NTIS HC A17/MF A01 CSCL 20F

The long term objectives are to develop a space qualified fiber optics transceiver for information networks applications on the Space Station, to advance the technology to increase the system data handling capability, to reduce the overall device size, and to improve efficiency and sensitivity. The characteristics of hybrid fiber optic transceivers and monolithic fiber optic transceivers are reviewed.

Author

N87-29165\*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SS FOCUSED TECHNOLOGY: GATEWAYS AND NOS'S

R. HARTENSTEIN /n NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, Volume 2 7 p Aug. 1985

Avail: NTIS HC A17/MF A01 CSCL 09B

The extensions and enhancements of the fiber optic data bus technology supported by the Space Station Focused Technology Program are discussed. This includes the operating software for the network called the Network Operating System (NOS); gateways and bridges for multiple network topologies; and very large scale topology implimentations to shrink the size and power of the Bus Interface Unit (BIU) down to more manageable dimensions. CMOS is being investigated for the lower speed (parallel) logic. Gallium arsendide is being studied for the high speed (serial) logic.

Author

N87-29166\*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**NETWORK OPERATING SYSTEM** 

In NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 6 p Aug. 1985 Avail: NTIS HC A17/MF A01 CSCL 09B

Long-term and short-term objectives for the development of a network operating system for the Space Station are stated. The short-term objective is to develop a prototype network operating system for a 100 megabit/second fiber optic data bus. The long-term objective is to establish guidelines for writing a detailed specification for a Space Station network operating system. Major milestones are noted. Information is given in outline form. R.J.F.

N87-29167\*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

NETWORK OPERATING SYSTEM FOCUS TECHNOLOGY

In NASA, Washington, Proceedings: Computer Science and Data
Systems Technical Symposium, Volume 2 10 p Aug. 1985

Avail: NTIS HC A17/MF A01 CSCL 09B

An activity structured to provide specific design requirements and specifications for the Space Station Data Management System (DMS) Network Operating System (NOS) is outlined. Examples are given of the types of supporting studies and implementation tasks presently underway to realize a DMS test bed capability to

develop hands-on understanding of NOS requirements as driven by actual subsystem test beds participating in the overall Johnson Space Center test bed program. Classical operating system elements and principal NOS functions are listed.

#### 13

#### **ACCOMMODATIONS**

Includes descriptions of simulations, analyses, trade studies, and requirements for safe efficient procedures, facilities, and support equipment on the ground and in space for processing, servicing, maintenance, reliability, commonality, verification and checkout of cargo and equipment.

#### A87-32529

#### THE SPACE STATION - WORK PACKAGE 3

LARRY P. YERMACK (RCA, Astro-Electronics Div., Princeton, NJ) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 1897-1904.

The features of the elements making up the U.S. Space Station Program are discussed. Emphasis is on Work Package 3, which has four elements: (1) two types of platforms (polar orbiting sun-synchronous platforms and platforms that coorbit at the same inclination as the Space Station Manned Base); (2) attached payload accommodations; (3) servicing requirements for the entire life cycle of the Space Station; and (4) laboratory module outfitting. Salient features of these elements are described together with the elements' functions. In addition, the details of the systems engineering and integration and the aspects of customer accommodation, product assurance, and advanced developments are discussed.

#### A87-32613

#### MAGNETIC REFRIGERATION FOR SPACE PLATFORMS

J. A. BARCLAY, F. C. PRENGER, W. F. STEWART, and C. B. ZIMM (Astronautics Corporation of America, Madison, WI) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 13-16, 1986. 9 p. refs (SAE PAPER 861724)

Cryogenic systems will be a part of the Space Station and future space platforms in a variety of applications, such as propellant management and cooling of scientific instruments. The projected Space Station initial usage of cryogenic propellants is relatively small so the primary refrigeration need is for cooling scientific instruments and various sensors. A potential method for meeting these cooling requirements is the use of a refrigerator based on the temperature changes in certain magnetic materials upon application or removal of a magnetic field; i.e., the magnetocaloric effect. This type of refrigerator, known as a magnetic refrigerator, offers potentially higher reliability and lower power requirements than conventional refrigation units. Also, the higher power density of the magnetic refrigerator is an attractive feature for Space Station and space platform applications.

Author

A87-33003\* McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.

## THE USE OF MULTIDIMENSIONAL SCALING FOR FACILITIES LAYOUT - AN APPLICATION TO THE DESIGN OF THE SPACE STATION

THOMAS S. TULLIS, BARBRA BIED SPERLING, and A. L. STEINBERG (McDonnell Douglas Astronautics Co., Huntington Beach, CA) IN: Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volume 1 . Santa Monica, CA, Human Factors Society, 1986, p. 38-42. refs (Contract NAS2-11723)

Before an optimum layout of the facilities for the proposed Space Station can be designed, it is necessary to understand the

functions that will be performed by the Space Station crew and the relationships among those functions. Five criteria for assessing functional relationships were identified. For each of these criteria, a matrix representing the degree of association of all pairs of functions was developed. The key to making inferences about the layout of the Space Station from these matrices was the use of multidimensional scaling (MDS). Applying MDS to these matrices resulted in spatial configurations of the crew functions in which smaller distances in the MDS configuration reflected closer associations. An MDS analysis of a composite matrix formed by combining the five individual matrices resulted in two dimensions that describe the configuration: a 'private-public' dimension and a 'group-individual' dimension. Seven specific recommendations for Space Station layout were derived from analyses of the MDS configurations. Although these techniques have been applied to the design of the Space Station, they can be applied to the design of any facility where people live or work.

#### A87-33048

## PLANNING FOR UNANTICIPATED SATELLITE SERVICING TELEOPERATIONS

JOHN R. RICE, JOHN P. YORCHAK, and CRAIG S. HARTLEY (Martin Marietta Corp., Denver, CO) IN: Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volume 2. Santa Monica, CA, Human Factors Society, 1986, p. 870-874. refs

The role that man will play in the space-based servicing of satellites will change with standardization and automation of such operations. If history is any indication, man cannot be completely removed from servicing duties because unanticipated servicing operations occasionally will require his direct intervention and control through either extra-vehicular activities (EVA) or teleoperations. As a result, certain minimum user-system interface capabilities must be maintained, no matter how sophisticated future technology becomes. This paper discusses research related to some of the basic human factors problems that will probably always have an impact on space-based teleoperated servicing operations. The implicit warning is that future advanced systems must implement solutions to these problems if humans are to provide effective backup support. Furthermore, it is believed that there are several critical gaps in the present knowledge of teleoperator human factors that must be closed before such backup operations can be effective. There is a danger that system developers may become so enamored of advanced teleoperator technology that they may fail to provide an adequate user/system interface for backup operations. Human factors issues discussed include: vision systems, control devices, and communication time delays.

Author

## A87-38710\* Life Systems, Inc., Cleveland, Ohio. EDC DEVELOPMENT AND TESTING FOR THE SPACE STATION PROGRAM

R. B. BOYDA and S. P. HENDRIX (Life Systems, Inc., Cleveland, OH) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 75-86. NASA-sponsored research.

(SAE PAPER 860918)

NASA's development of electrochemical CO2 concentration technology has led to the creation of subsystem hardware and control and monitoring instrumentation that are ideally suited to Space Station program applications; only seven orbital replacement units, for instance, are required for the performance of process functions. This process simplification leads to superior reliability and enhanced maintainability. Hardware and software features that enhance subsystem reliability through fault detection and isolation have been emphasized in the course of development. Further power, weight, and volume savings, together with enhanced maintainability, are also foreseen in prospective developments of these subsystems.

**A87-38722\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

SPACE STATION GALLEY DESIGN

RUDY TRABANINO (NASA, Johnson Space Center, Houston, TX), GEORGE L. MURPHY, and M. M. YAKUT (McDonnell Douglas Astronautics Co., Huntington Beach, CA) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 201-206. (SAE PAPER 860932)

An Advanced Food Hardware System galley for the initial operating capability (IOC) Space Station is discussed. Space Station will employ food hardware items that have never been flown in space, such as a dishwasher, microwave oven, blender/mixer, bulk food and beverage dispensers, automated food inventory management, a trash compactor, and an advanced technology refrigerator/freezer. These new technologies and designs are described and the trades, design, development, and testing associated with each are summarized.

## A87-38742\* General Electric Co., Philadelphia, Pa. SCIENCE RESEARCH FACILITIES - VERSATILITY FOR SPACE STATION

J. A. GIANNOVARIO, J. D. SCHELKOPF, K. MASSEY, and M. SOLLY (General Electric Co., Space Div., Valley Forge, PA) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 435-438. (Contract NAS5-29300)

(SAE PAPER 860958)

The Space Station Science Lab Module (SLM) and its interfaces are designed to minimize complexity and maximize user accommodations. The facilities provided encompass life sciences research, the control of external payloads, the servicing of customer equipment, and general scientific investigations. The SLM will have the unprecedented ability to diagnose, service, and replace equipment while in orbit. In addition, the SLM will have significant operational advantages over previous spacecraft in terms of available volume, power, and crew interaction possibilities. O.C.

**A87-38784\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

## AN IMPROVED WASTE COLLECTION SYSTEM FOR SPACE FLIGHT

WILLIAM E. THORNTON, WILLIAM W. LOFLAND, JR. (NASA, Johnson Space Center, Houston, TX), and HENRY WHITMORE (Whitmore Enterprises, San Antonio, TX) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 891-895. refs (SAE PAPER 861014)

Waste collection systems are a critical part of manned space flight. Systems to date have had a number of deficiencies. A new system, which uses a simple mechanical piston compactor and disposable pads allows a clean area for defecation and maximum efficiency of waste collection and storage. The concept has been extensively tested. Flight demonstration units are being built, tested, and scheduled for flight. A prototype operational unit is under construction. This system offers several advantages over existing or planned systems in the areas of crew interface and operation, cost, size, weight, and maintenance and power consumption.

Author

## A87-40363 COMPLEX SYSTEM MONITORING AND FAULT DIAGNOSIS USING COMMUNICATING EXPERT SYSTEMS

J. Y. READ, T. P. HOWLAND, and W. A. PERKINS (Lockheed Missiles and Space Co., Inc., Palo Alto, CA) IN: EASCON '86; Proceedings of the Nineteenth Annual Electronics and Aerospace

Systems Conference, Washington, DC, Sept. 8-10, 1986. New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 102-109. refs

Using an enhanced version of the Lookheed Expert System, a communicating expert system for fault diagnosis and fault correction in a prototype for the Space Station Air Revitalization System was developed. The system consists of three communicating expert systems, one for oxygen generation; one for CO2 removal; and a supervisor for overall control. The three expert system modules communicate via mailboxes. The purpose of this work is to gain an understanding of the problems involved and advantages of using such a communicating expert systems framework. Author

#### A87-41870

## EXPECTED SIZE OF A CRATER RESULTING FROM THE IMPACT OF A MICROMETEORITE [OZHIDAEMYI RAZMER KRATERA PRI UDARE MIKROMETEORITA]

M. M. RUSAKOV and M. A. LEBEDEV Fizika Goreniia i Vzryva (ISSN 0430-6228), vol. 23, Jan.-Feb. 1987, p. 95-98. In Russian. refs

An experimental study is made of the impact of a compact mass (a cylindrical cluster of tungsten particles with a density up to 1 g/cu cm) against targets of various structural materials, with impact velocities reaching 27 km/s. It is found that experimental results are adequately approximated, using the least squares method, by a linear relationship; the mean ejection velocity of the target mass is estimated at 1.5 km/s. The relationships presented here are also valid for spherical particles at impact velocities up to about 25 km/s. Calculations for targets of AMG6M aluminum alloy are presented.

**A87-48582\***# National Aeronautics and Space Administration, Washington, D.C.

#### SCIENTIFIC CUSTOMER NEEDS - NASA USER

DAVID C. BLACK (NASA, Washington, DC) AIAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 4 p. (AIAA PAPER 87-2196)

Some requirements for scientific users of the Space Station are considered. The use of testbeds to evaluate design concepts for information systems, and for interfacing between designers and builders of systems is examined. The need for an information system that provides an effective interaction between ground-based users and their space-based equipment is discussed.

A87-48597\*# Ford Aerospace and Communications Corp., College Park, Md.

## INTEGRATED SCHEDULING AND RESOURCE MANAGEMENT M. T. WARD (Ford Aerospace and Communications Corp., College

M. I. WAHD (Ford Aerospace and Communications Corp., College Park, MD) AlAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 11 p. refs

(Contract NAS5-2750)

(AIAA PAPER 87-2213)

This paper examines the problem of integrated scheduling during the Space Station era. Scheduling for Space Station entails coordinating the support of many distributed users who are sharing common resources and pursuing individual and sometimes conflicting objectives. This paper compares the scheduling integration problems of current missions with those anticipated for the Space Station era. It examines the facilities and the proposed operations environment for Space Station. It concludes that the pattern of interdependecies among the users and facilities, which are the source of the integration problem is well structured, allowing a dividing of the larger problem into smaller problems. It proposes an architecture to support integrated scheduling by scheduling efficiently at local facilities as a function of dependencies with other facilities of the program. A prototype is described that is being developed to demonstrate this integration concept. Author

McDonnell-Douglas Astronautics Co., St. Louis, N87-20351\*# Mo.

ADVANCED EVA SYSTEM DESIGN REQUIREMENTS STUDY: **EVAS/SPACE STATION SYSTEM INTERFACE** REQUIREMENTS

T. G. WOODS 15 Nov. 1985 122 p

(Contract NAS9-17299)

(NASA-CR-171981; NAS 1.26:171981; MDC-W0070) Avail: NTIS HC A06/MF A01 CSCL 22B

The definition of the Extravehicular Activity (EVA) systems interface requirements and accomodations for effective integration of a production EVA capability into the space station are contained. A description of the EVA systems for which the space station must provide the various interfaces and accomodations are provided. The discussion and analyses of the various space station areas in which the EVA interfaces are required and/or from which implications for EVA system design requirements are derived, are included. The rationale is provided for all EVAS mechanical, fluid, electrical, communications, and data system interfaces as well as exterior and interior requirements necessary to facilitate EVA operations. Results of the studies supporting these discussions are presented in the appendix.

Air Force Inst. of Tech., Wright-Patterson AFB, N87-22762# Ohio. School of Engineering.

**DEVELOPING A VOICE-CONTROLLED,** COMPUTER-GENERATED DISPLAY TO ASSIST SPACE STATION ASTRONAUTS DURING MAINTENANCE ACTIVITY M.S. Thesis

PAUL J. PABICH Dec. 1986 240 p (AD-A178997; AFIT/GSO/ENG/86D-1) Avail: NTIS HC A11/MF A01 CSCL 22B

This thesis illustrated a planning strategy for a voice-controlled, computer-generated maintenance display which would be used by astronauts when completing maintenance activity outside the proposed U.S. space station. After justifying the usefulness of a proposed systems engineering approach, five main objectives were provided: (1) the vertical stanchion of the Manipulator Foot Restraint would provide an adequate base for the display so it could be moved to and from the worksite; (2) liquid crystal display technology should be used; (3) for voice-controlled operations, the best type of recognition unit to use would be one where the unit understands only one speaker at a time and only one word at a time; (4) experimental data suggest that a hierarchical scheme should be used for the menu format; (5) use of text, audio, graphics, and color for the proposed display. Only text and graphics were recommended for use. A proposed display format was presented showing the placement of the menu, text and graphics using some known data about how the human brain processes information.

**GRA** 

N87-24162\*# National Academy of Sciences - National Research Council, Washington, D. C. Committee on Hearing, Bioacoustics, and Biomechanics.

**GUIDELINES FOR NOISE AND VIBRATION LEVELS FOR THE SPACE STATION** 

Jun. 1987 39 p

(Contract NASA ORDER L-76724-B)

(NASA-CR-178310; NAS 1.26:178310) Avail: NTIS HC A03/MF

CSCL 20A

Human habitability noise and vibration guidelines for the Space Station are presented. These were developed by a working group of experts established by the Committee on Hearing, Bioacoustics, and Biomechanics (CHABA) of the National Research Council's Commission on Behavioral and Social Science and Education. Noise exposure limits are suggested that will permit adequate speech communication, sleep, and hearing safety. Vibration exposure limits are suggested which will provide adequate comfort and permit adequate task performance. These are provided for quidance only for setting criteria. The exact criteria will depend on Space Station design and duty cycles.

14

#### **GROWTH**

Includes descriptions of scenarios, analyses and system technology requirements for the evolutionary growth of the Space Station system.

A87-38754\* Management and Technical Services Co., Houston,

#### CONCEPTS FOR THE EVOLUTION OF THE SPACE STATION **PROGRAM**

ROGER B. MICHAUD, LADONNA J. MILLER (GE Management and Technical Services Co., Houston, TX), and GARY R. PRIMEAUX (NASA, Johnson Space Center, Houston, TX) Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986 . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 561-570. refs (SAE PAPER 860972)

An evaluation is made of innovative but pragmatic waste management, interior and exterior orbital module construction, Space Shuttle docking, orbital repair operation, and EVA techniques applicable to the NASA Space Station program over the course of its evolution. Accounts are given of the Space Shuttle's middeck extender module, an on-orbit module assembly technique employing 'Pringles' stack-transportable conformal panels, a flexible Shuttle/Space Station docking tunnel, an 'expandable dome' for transfer of objects into the Space Station, and a Space Station dual-hatch system. For EVA operations, pressurized bubbles with articulating manipulator arms and EVA hard suits incorporating maneuvering, life support and propulsion capabilities, as well as an EVA gas propulsion system, are proposed. A Space Station ultrasound cleaning system is also discussed.

National Aeronautics and Space Administration. A87-40353\*# Lyndon B. Johnson Space Center, Houston, Tex.

#### ADVANCED TECHNOLOGY FOR THE SPACE STATION

MARK B. NOLAN and DENNIS A. STONE (NASA, Johnson Space IN: EASCON '86; Proceedings of the Center, Houston, TX) Nineteenth Annual Electronics and Aerospace Systems Conference, Washington, DC, Sept. 8-10, 1986 . New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 24-32.

The goals and objectives of the Space Station Advanced Development Program are discussed. Data from tests and experiments in the areas of attitude control and stabilization, communications and tracking, data management systems, man systems, mechanisms, power systems, structures, thermal systems, and EVA are examined. The approaches used to implement these programs and for data transfer are described. The plans for the development of the Space Station are presented.

N87-20340\*# Bionetics Corp., Hampton, Va. AN ADVANCED TECHNOLOGY SPACE STATION FOR THE YEAR 2025, STUDY AND CONCEPTS Contractor Report, May-Nov. 1986

M. J. QUEIJO, A. J. BUTTERFIELD, W. F. CUDDIHY, C. B. KING, and P. A. GARN Mar. 1987 191 p

(Contract NAS1-18267)

(NASA-CR-178208; NAS 1.26:178208) Avail: NTIS HC A09/MF A01 CSCL 22B

A survey was made of potential space station missions that might exist in the 2020 to 2030 time period. Also, a brief study of the current state-of-the-art of the major subsystems was undertaken, and trends in technologies that could impact the subsystems were reviewed. The results of the survey and study were then used to arrive at a conceptual design of a space station for the year 2025. Factors addressed in the conceptual design included requirements for artificial gravity, synergies between subsystems, and the use of robotics. Suggestions are made relative

to more in-depth studies concerning the conceptual design and alternative configurations.

N87-23674\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SPECULATIONS ON FUTURE OPPORTUNITIES TO EVOLVE BRAYTON POWERPLANTS ABOARD THE SPACE STATION ROBERT E. ENGLISH 1987 29 p Presented at the 4th Symposium on Space Nuclear Power Systems, Albuquerque, N. Mex., 12-16 Jan. 1987; sponsored by Sandia National Labs. (NASA-TM-89863; E-3530; NAS 1.15:89863) Avail: NTIS HC A03/MF A01 CSCL 10B

The Space Station provides a unique, low-risk environment in which to evolve new capabilities. In this way, the Space Station will grow in capacity, in its range of capabilities, and its economy of operation as a laboratory and as a center for space operations. Although both Rankine and Brayton cycles, two concepts for solar dynamic power generation, now compete to power the station, this paper confines its attention to the Brayton cycle using a mixture of He and Xe as its working fluid. Such a Brayton powerplant to supply the station's increasing demands for both electric power and heat has the potential to gradually evolve higher and higher performance by exploiting already-evolved materials (ASTAR-811C and molten-Li heat storage), its peak cycle temperature rising ultimately to 1500 K. Adapting the station to exploit long tethers (200 to 300 km long) could yield increases in payloads to LEO, to GEO, and to distant destinations in the solar system. Such tethering of the Space Station would not only require additional power for electric propulsion but also would so increase nuclear safety that nuclear powerplants might provide this power. From an 8000-kWt SP-100 reactor, thermoelectric power generation could produce 300 kWe, or adapted solar-Brayton cycle, 2400 to 2800 kWe.

Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn N87-26841 (West Germany). Space Systems Group.
THE EVOLUTION OF A SERVICEABLE EURECA

J. WEYANDT, H. P. RICHARZ, H. WARTENBERG, and L. KERSTEIN In its Research and Development. Technical-Scientific Publications 1986 p 195-206 1986 Presented at the 37th IAF-Congress, Innsbruck, Austria, 6-10 Oct. 1986 announced in IAA as A87-15825

(MBB-UR-E-923/86; IAF-86-38) Avail: Issuing Activity

The evolution of the ground-based platform EURECA is depicted. The platform design and the adaptation to scientific missions and servicing operations are explained. The cost-effective utilization of the different platform types using new operational concepts is analyzed in parametric life cycle cost calculations for different payloads and mission scenarios. By covering of broad spectrum of user requirements, EURECA could capture a wider payload market.

15

#### MISSIONS, TETHERS, AND PLATFORMS

Includes descriptions and requirements of missions and tethers onboard the Space Station and platforms that are either co-orbiting with the Space Station, in polar orbit, or in geosynchronous orbit and which are part of the Space Station system.

A87-32192\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**HOLLOW CATHODE-BASED PLASMA CONTACTOR** EXPERIMENTS FOR ELECTRODYNAMIC TETHER

MICHAEL J. PATTERSON (NASA, Lewis Research Center, Cleveland, OH) AIAA, Aerospace Sciences Meeting, 25th, Reno, NV, Jan. 12-15, 1987. 46 p. refs (AIAA PAPER 87-0572)

The role plasma contactors play in effective electrodynamic

tether operation is discussed. Hollow cathodes and hollow cathode-based plasma sources have been identified as leading candidates for the electrodynamic tether plasma contactor. Present experimental efforts to evaluate the suitability of these devices as plasma contactors are reviewed. This research includes the definition of preliminary plasma contactor designs, and the characterization of their operation as electron collectors from a simulated space plasma. The discovery of an 'ignited mode' regime of high contactor efficiency and low impedance is discussed, as well as is the application of recent models of the plasma coupling process to contactor operation. Results indicate that ampere-level electron currents can be exchanged between hollow cathode-based plasma contactors and a dilute plasma in this regime. A discussion of design considerations for plasma contactors is given which includes expressions defining the total mass flow rate and power requirements of plasma contactors operating in both the cathodic and anodic regimes, and correlation of this to the tether current. Finally, future ground and spaceflight experiments are proposed to resolve critical issues of plasma contactor operation.

#### A87-32236\*# Johns Hopkins Univ., Laurel, Md. CONFIGURATION TRADEOFFS FOR THE SPACE INFRARED TELESCOPE FACILITY POINTING CONTROL SYSTEM

A. J. PUE, K. STROHBEHN, and J. W. HUNT (Johns Hopkins University, Laurel, MD) (Guidance, Navigation and Control Conference, Snowmass, CO, Aug. 19-21, 1985, Technical Papers, p. 73-82) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 10, Mar.-Apr. 1987, p. 209-215. NASA-sponsored research. Previously cited in issue 22, p. 3241, Accession no. A85-45885. refs

#### A87-32288 **GEOSTATIONARY PLATFORMS - AN INTERNATIONAL PERSPECTIVE**

ROBERT E. BERRY, NEIL J. BARBERIS, and PAUL A. MONTE (Ford Aerospace and Communications Corp., Development Laboratories Div., Palo Alto, CA) IN: Int IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 1 . Tokyo, AGNE Publishing, Inc., 1986, p. 79-82.

Past studies of geostationary platforms have focused on its communications capabilities and have tended to develop this resource within the context of national and/or regional services. The economic viability of these platforms are measured within this synoptic scale through comparison with implementation schemes utilizing individual satellites. The authors contend, however, that the primary characteristics of a geostationary platform (namely, aggregation of services, economies of scale, and connectivity) demand that the platforms be developed and their viability measured within the context of a 'global communications' architecture. This architecture would comprise sets of platforms, each providing regional services and east/west connectivity among the three designated International Telecommunications Union (ITU) regions. This global concept can be achieved only if the operational interfaces between the platform sets are compatible. This compatibility can only be assured if the various platform studies are coordinated and a test bed platform is developed to validate these operational concepts and interfaces.

#### A87-32521 PRELIMINARY RESULTS OF CHARGE-2 TETHERED **PAYLOAD EXPERIMENT**

S. SASAKI, K. I. OYAMA, N. KAWASHIMA, T. OBAYASHI (Tokyo, University, Japan), K. HIRAO (Tokai University, Hiratsuka, Japan) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2 . Tokyo, AGNE Publishing, Inc., 1986, p. 1835-1840.

Data from the CHARGE-2 tethered payload experiment are analyzed. The CHARGE-2 experiment, which was to inject an electron beam using a tethered mother-daughter payload system, was conducted on December 14, 1985 at White Sands Missile Range, NM. The payload instruments launched by the Black Brant and Terrier rockets, and the beam firing sequence are described.

#### 15 MISSIONS, TETHERS, AND PLATFORMS

It is determined that the average wire length reached was 426 m during 289 sec and the average speed during deployment was 1.47 m/sec; a correlation between the reaction control system firings and an increase in velocity was observed. The data reveal that charging was lower at higher altitudes when the beam current was less than 80 mA. Consideration is given to tether current with and without beam emission, beam trajectory, VLF wave enhancement with tether deployment, and wave generation by beam emissions.

#### A87-32533

## ON THE PAYLOAD-TETHER TECHNOLOGY PROVIDING THE MICROGRAVITY CIRCUMSTANCES IN THE PROXIMITY OF THE SPACE STATION

SHOICHI YOSHIMURA and TATSUO YAMANAKA (National Aerospace Laboratory, Chofu, Japan) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 1921-1926. refs

Preliminary results on a study of payload-tether technology, in which an upward or downward deployable experimental payload is connected to the Space Station through a tether to attenuate the propagation of G-jitters during microgavity experiments, are presented. Simplified models of the tether/payload system demonstrate the frequency separation of the natural frequency of the system from the G-jitter spectrum, and indicate a 260-m permissible tether length for 500-km altitude circular orbit. Numerical simulations of the system dynamics without control are performed using a Space Station/tether/payload system model. It is suggested that additional consideration is necessary on the definition of the residual force in the payload, directly related to the G level.

#### A87-32536

### ADVANCED TECHNOLOGY EXPERIMENT ONBOARD SPACE

KYOICHI KURIKI (Tokyo, University, Japan) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2 . Tokyo, AGNE Publishing, Inc., 1986, p. 1951-1956.

The experiments tentatively planned to be performed aboard the Space Flyer Unit (SFU), a small free-flying space platform which is designed as an observatory carrying a telescope and a test bed for advanced technology and to be carried and deployed by the STS, are discussed. The following experiments, which are the candidates for the SFU, are described in detail: (1) the Two-Dimensional Array Deployment, (2) the High-Voltage Solar Array Experiment, (3) the Electric Propulsion Experiment, (4) the Microwave Power Transmission Experiment, (5) the Space Experiment with Particle Accelerators, (6) the Tether Subsatellite Experiment, (7) the Satelllite Retrieval Experiment, (8) the Biology Experiment, (9) the Solidification and Crystal Growth Experiment, and (10) the High-Precision Pointing System for Infrared Telescope. Multiple configuration diagrams are presented.

## A87-32538 DESIGN OF A POLAR PLATFORM WITH AN EARTH OBSERVATION PAYLOAD

F. E. SAWDON (British Aerospace, PLC, Space and Communications Div., Bristol, England) and D. W. S. LODGE (British National Space Centre, London, England) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2 . Tokyo, AGNE Publishing, Inc., 1986, p. 1965-1969.

The European polar platform (EPP) segment of the ESA Columbus contribution to the Space Station is to have an indefinite on-orbit lifetime, achieved by manned servicing to changeout experiments, failed components and replenish consumables. Meteorology, oceanography, atmospheric monitoring, and land and littoral monitoring applications are foreseen for the platform, which will have an initial payload of 2.4 tons and have a 5 kW power supply. The nominal orbit will be sun-synchronous at 850 km altitude with an average 102 min period. Three modules, propulsion, utilities

and payload, will be launched by the Shuttle. The modules will be assembled with the RMS aided by EVA astronauts performing final checkouts. The procedures and equipment for scheduled 2 yr Shuttle servicing missions are delineated, along with data transmission system features and the use of orbital replacement units for payload and utilities changeouts.

M.S.K.

#### A87-33687# SOME APPROXIMATIONS FOR THE DYNAMICS OF SPACECRAFT TETHERS

A. H. VON FLOTOW (MIT, Cambridge, MA) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Part 2A. New York, American Institute of Aeronautics and Astronautics, 1987, p. 314-321. USAF-sponsored research. refs (AIAA PAPER 87-0821)

The dynamics of typical tethered spacecraft systems are studied in an expository approximate way, with spectral separation invoked to reduce the dynamics of the system to a relatively fast vibrational motion which is decoupled from and superimposed upon the slow roll/yaw librations of the system. The fast tether vibrations occur with respect to a slowly varying quasi-equilibrium. The equilibrium shape of the tether is shown to be slightly nonlinear, and the small perturbations from this equilibrium are given by a system of linear partial differential equations. Nondimensional parameter groups which govern the character of the fast tether vibration are specified.

#### A87-34871 SPACE STATION - OPPORTUNITIES FOR THE LIFE SCIENCES

M. H. HARRISON (RAF, Institute of Aviation Medicine, Farnborough, England) British Interplanetary Society, Journal (Space Chronicle) (ISSN 0007-084X), vol. 40, March 1987, p. 117-124. refs

Opportunities for bioprocessing, basic biological research and space medicine offered by the Space Station are examined. Space offers two conditions which are duplicated on earth only with great difficulty; microgravity and high vacuum. Microgravity permits enhanced control of temperature and concentration gradients and particle distributions in fluids and containerless processing. Several likely candidates for electrophoresis processing in space are identified, noting that the greatest obstacle to realizing the new industry is commercial doubts as to its viability. Areas of cell and animal physiology, radiation biology, and exobiology that would benefit from Space Station research are considered. Finally, necessary space medicine research, by NASA and ESA, in medicine, toxicology, human factors, psychology, and adaptation to microgravity in support of the Space Station program are explored.

## A87-35222\* Arizona Univ., Tucson. ASTROMETRIC TELESCOPE OF TEN MICROARCSECOND ACCURACY ON THE SPACE STATION

E. H. LEVY, R. S. MCMILLAN (Arizona, University, Tucson), G. D. GATEWOOD, and J. W. STEIN (Allegheny Observatory, Pittsburgh, PA) IN: Advanced technology optical telescopes III; Proceedings of the Meeting, Tucson, AZ, Mar. 3-6, 1986. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1986, p. 181-187. refs

(Contract NAG2-348)

The Astrometric Telescope Facility (ATF) will be operated in the NASA Space Station in the 1990s, furnishing long term, highly accurate relative astrometry of nearby stars in order to detect gravitational perturbations by companion stars with masses as small as that of Neptune. An accuracy of 10 microarcsec is required; this is 100 times better than ground observatory performance. In the Gatewood et al. (1980) astrometric technique used, the relative positions of star images in the telescope focal plane are indicated by the relative phases of the modulations of star brightnesses introduced by translating a Ronchi ruling across the focal plane at

uniform speed. Space Station vibration damping, fine guiding accuracy, optical configuration, Ronchi ruling metric accuracy, and the choice of detectors, are discussed.

O.C.

**A87-36531\*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

### DESIGN CONSIDERATIONS FOR LONG-LIVED GLASS MIRRORS FOR SPACE

FRANK L. BOUQUET, CARL R. MAAG (California Institute of Technology, Jet Propulsion Laboratory, Pasadena), and PHILIP M. HEGGEN (Energy General, Menlo Park, CA) IN: Materials and optics for solar energy conversion and advanced lighting technology; Proceedings of the Meeting, San Diego, CA, Aug. 19-21, 1986. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1987, p. 94-101. DOE-sponsored research. refs

Large mirrors intended for long-term operation in orbital space will have to retain high reflectance in the presence of contamination or destruction by high-energy particles, meteorites, and orbiting debris. These conditions require the use of low-energy outer surfaces that resist the buildup of contamination, the use of small mirror segments that restrict local damage and facilitate replacement, and the use of surface coatings that minimize the effects of atomic oxygen and/or charge buildup. The present recommendations are based on experience accumulated with terrestrial solar-concentrator mirror materials.

#### A87-37785

#### CODED MASK TELESCOPES FOR X-RAY ASTRONOMY

G. K. SKINNER and T. J. PONMAN (Birmingham, University, England) British Interplanetary Society, Journal (Space Science) (ISSN 0007-084X), vol. 40, April 1987, p. 169-172. refs The principle of the coded mask techniques are discussed

The principle of the coded mask techniques are discussed together with the methods of image reconstruction. The coded mask telescopes built at the University of Birmingham, including the SL 1501 coded mask X-ray telescope flown on the Skylark rocket and the Coded Mask Imaging Spectrometer (COMIS) projected for the Soviet space station Mir, are described. A diagram of a coded mask telescope and some designs for coded masks are included.

#### A87-38002#

#### STATUS OF THE RITA - EXPERIMENT ON EURECA

H. BASSNER, H.-P. BERG, W. BIRNER (MBB-ERNO Raumfahrttechnik GmbH, Ottobrunn, West Germany), C. BARTOLI, and A. TRIPPI (ESA, European Space Research and Technology Centre, Noordwijk, Netherlands) AIAA, DGLR, and JSASS, International Electric Propulsion Conference, 19th, Colorado Springs, CO, May 11-13, 1987. 6 p. (AIAA PAPER 87-0988)

The radiofrequency ion thruster assembly (RITA) is currently built as a flight experiment which shall be flown on the European retrievable carrier (Eureca I). This test flight shall verify the operational use of this electric propulsion system in space by demonstration of operation, lifetime and reliability. For this purpose the RITA experiment has been adapted to meet the specific constraints imposed by the Eureca I spacecraft and by the Space Shuttle as the launcher; xenon gas will be used as the propellant and the experiment will be operated automatically by means of a dedicated on-board microcomputer system. According to the delay in launches by the Space Shuttle the launch date has been postponed from March 1988 to 1991/92. Therefore the total Eureca program has been extended, which also influenced the RITA time schedule.

# A87-38567\* Howard Univ., Washington, D. C. TETHERS IN SPACE; PROCEEDINGS OF THE INTERNATIONAL CONFERENCE, ARLINGTON, VA, SEPT. 17-19, 1986

PETER M. BAINUM, ED. (Howard University, Washington, DC), IVAN BEKEY, ED. (NASA, Office of Space Flight, Washington, DC), LUCIANO GUERRIERO, ED. (CNR, Rome, Italy), and PAUL A. PENZO, ED. (California Institute of Technology, Jet Propulsion

Laboratory, Pasadena) Conference sponsored by NASA, CNR, AIAA, AAS, et al. San Diego, CA, Univelt, Inc., 1987, 765 p. For individual items see A87-38568 to A87-38574.

A collection of papers on the applications of tethers in space is presented. Tether flight experiments of the past, in planning stages, and in the future are examined. Tether dynamics and the applications and technical aspects of electrodynamic tethers are addressed. The use of tethers on the Space Station and applications in the Space Station era are considered. Individual tether technology issues, including tether materials and instrumentation for atmospheric measurements are discussed.

C.D.

**A87-38568\*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

### A SURVEY OF TETHER APPLICATIONS TO PLANETARY EXPLORATION

PAUL A. PENZO (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Tethers in space; Proceedings of the International Conference, Arlington, VA, Sept. 17-19, 1986 . San Diego, CA, Univelt, Inc., 1987, p. 71-88. refs (AAS PAPER 86-206)

Concepts for the use of tethers in various hypothetical astronomical research missions are discussed. Tethers used to study the atmospheres of Venus and Mars and the magnetosphere of Jupiter are examined, and possible orbiting tether systems at the moon and Mars are shown and described. A tether method for collecting a sample from Comet Halley is addressed along with a system for hovering near a comet. A multiple sample return system for asteroids is described, and a heliocentric Alfven engine concept to study the solar wind is discussed.

#### A87-38570

#### TETHERED SATELLITE PROGRAM CONTROL STRATEGY

CARL S. BODLEY and HOWARD A. FLANDERS (Martin Marietta Corp., Denver, CO) IN: Tethers in space; Proceedings of the International Conference, Arlington, VA, Sept. 17-19, 1986. San Diego, CA, Univelt, Inc., 1987, p. 295-299. (AAS PAPER 86-221)

This presentation covers the essential equations for the control of the libration of a tethered system during the retrieval phase. Based on the assumption of ideal tension control and range and range rate feedback, theoretical regions of stability are determined for constant in-plane libration angles. These results are obtained by transforming the relative motion perturbation equations to a set of second order equations with constant coefficients. This resulting set of equations is analyzed in the frequency domain to generate stable retrieval angle limits as a function of the range and range rate error feedback gains. These stability boundaries are verified with nonlinear time domain simulations. The equations for shaping deployment and retrieval profiles are also presented.

Author

A87-38571\* Jet Propulsion Lab., California Inst. of Tech.,

### TETHER POWER SUPPLIES EXPLOITING THE CHARACTERISTICS OF SPACE

CHRISTOPHER PURVIS (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Tethers in space; Proceedings of the International Conference, Arlington, VA, Sept. 17-19, 1986 . San Diego, CA, Univelt, Inc., 1987, p. 407-438. refs

(AAS PAPER 86-227)

The author presents an alternative approach to the conception and design of future space power systems, with a particular emphasis on the use of tethers in space. Two concepts are presented in support of this design approach. The first concept is a secondary power system for large-scale energy storage and release, and the second is a prime power system for large-scale production of electrical power from the solar flux. In each case basic equations are presented, discussed, and point design values are given as examples. The technology of superconduction is found

to be greatly enhancing for the first concept, and the development of very light weight solar reflectors is considered enabling for the second.

#### A87-38573

#### TETHER SYSTEM AND CONTROLLED GRAVITY

LUIGI G. NAPOLITANO, RODOLFO MONTI, and GENNARO RUSSO (Napoli, Universita, Naples, Italy) IN: Tethers in space; Proceedings of the International Conference, Arlington, VA, Sept. 17-19, 1986 . San Diego, CA, Univelt, Inc., 1987, p. 589-605. CNR-supported research. refs (AAS PAPER 86-240)

The use of tethers to create an environment of controlled microgravity in space is examined. The study of the effects of gravity on a generic parameter X using controlled microgravity is considered. Scientific and commercial applications of a controllable g-field are briefly addressed, and the use of tether systems as microgravity platforms is discussed, indicating the types of experiments that could be performed on such platforms.

National Aeronautics and Space Administration, A87-38574\* Washington, D.C.

#### **TECHNOLOGY AND APPLICATIONS - CONVERGENCE TO A TETHER CAPABILITY**

JOHN L. ANDERSON (NASA, Office of Aeronautics and Space Technology, Washington, DC) IN: Tethers in space; Proceedings of the International Conference, Arlington, VA, Sept. 17-19, 1986 . San Diego, CA, Univelt, Inc., 1987, p. 635-643. refs (AAS PAPER 86-244)

In this paper, a convergence of interest from many potential tether applications is synthesized into one application that could be satisfied by a tethered satellite capability. This application is the use of a tethered research satellite deployed downward from the Shuttle Orbiter to gather scientific and engineering/technology data about the outer atmosphere from about 90 to 130 km. The atmospheric and aerothermodynamic information needed about this region of the atmosphere is identified, and the specific applications of that information, the tether capability, and the technology needed to gather the data are described.

National Aeronautics and Space Administration. A87-38756\* Ames Research Center, Moffett Field, Calif.

#### LIFE SCIENCE RESEARCH FACILITY MATERIALS MANAGEMENT REQUIREMENTS AND CONCEPTS

CATHERINE C. JOHNSON (NASA, Ames Research Center, Moffett IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986 . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 579-585. (SAE PAPER 860974)

The Advanced Programs Office at NASA Ames Research Center has defined hypothetical experiments for a 90-day mission on Space Station to allow analysis of the materials necessary to conduct the experiments and to assess the impact on waste processing of recyclable materials and storage requirements of samples to be returned to earth for analysis as well as of nonrecyclable materials. The materials include the specimens themselves, the food, water, and gases necessary to maintain them, the expendables necessary to conduct the experiments. and the metabolic products of the specimens. This study defines the volumes, flow rates, and states of these materials. Process concepts for materials handling will include a cage cleaner, trash compactor, biological stabilizer, and various recycling devices.

Author

#### A87-38757\* Boeing Aerospace Co., Seattle, Wash. PLANT AND ANIMAL ACCOMMODATION FOR SPACE STATION LABORATORY

RICHARD L. OLSON, EDITH A. GUSTAN, and LOWELL F. WILEY (Boeing Aerospace Co., Seattle, WA) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986 . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p.

587-601. refs (Contract NAS8-35471) (SAE PAPER 860975)

An extended study has been conducted with the goals of defining and analyzing relevant parameters and significant tradeoffs for the accommodation of nonhuman research aboard the NASA Space Station, as well as conducting tradeoff analyses for orbital reconfiguring or reoutfitting of the laboratory facility and developing laboratory designs and program plans. The two items exerting the greatest influence on nonhuman life sciences research were identified as the centrifuge and the specimen environmental control and life support system; both should be installed on the ground rather than in orbit.

#### A87-39183

#### THE TETHERED SATELLITE SYSTEM AS A NEW REMOTE SENSING PLATFORM

S. VETRELLA and A. MOCCIA (Napoli, Universita, Naples, Italy) International Journal of Remote Sensing (ISSN 0143-1161), vol. 8, March 1987, p. 369-383. Research supported by the Ministero della Pubblica Istruzione and CNR. refs

The characteristics and development of the Tethered Satellite (TS), which is to be a space platform that allows operation at different low altitudes, are described. Two experimental flights are proposed for the TS; the first mission involves deploying the tether 20 km upwards, and in the second mission the TS is to be deployed downwards to 100 km from the Shuttle. The attitude stability rates of the TS for along-track stereoscopic observations using linear arrays are analyzed. It is determined that an attitude stability rate of 10 to the -6th deg/sec is required for automatic correlation along epipolar planes during the proposed Mapsat mission and a rate of 0.00001 deg/sec is needed for the Stereosat mission.

I.F.

National Aeronautics and Space Administration. A87-40319\*# Lyndon B. Johnson Space Center, Houston, Tex.

#### **EXPERIMENTATION IN PLANETARY GEOLOGY**

MARK J. CINTALA (NASA, Johnson Space Center, Houston, TX) Reviews of Geophysics (ISSN 8755-1209), vol. 25, March 1987, p. 304-308. refs

Laboratory simulations of geological processes on the terrestrial planets are described, summarizing results published during the period 1983-1986. Included are studies of wind-driven processes on Mars and Venus (using the special wind-tunnel facilities at NASA Ames); simulations of shock-induced loss of volatiles from solids; equation-of-state determinations; impact experiments simulating cratering, spallation, regolith formation, and disruption; fluid-flow simulations of channel formation on Mars; and dust studies. The use of the microgravity environment of the Space Station for planetary-geology experiments is briefly considered.

T.K.

#### A87-40510#

#### **ELECTRODYNAMIC TETHER PROPULSION - POTENTIAL USES AND OPEN ISSUES**

JOSEPH A. CARROLL, JOHN C. OLDSON (Energy Science Laboratories, Inc., San Diego, CA), and WILLIAM B. THOMPSON (California, University, San Diego) International Electric Propulsion Conference, 19th, Colorado Springs, CO, May 11-13, 1987, Paper. 4 p.

A current flowing through a long straight wire or conducting tether in earth orbit (and returning externally through the ionosphere) will react against the earth's magnetic field and can provide propulsion - without expending reaction mass. If such an electrodynamic tether is practical, it may be simpler and more efficient - in use of power and mass - than any other form of electric propulsion. This paper reviews this concept and potential applications, and discusses some key unresolved issues. Author

#### A87-40858#

ORBITAL MODIFICATIONS USING FORCED TETHER-LENGTH **VARIATIONS** 

MANUEL MARTINEZ-SANCHEZ and SARAH A. GAVIT (MIT, Cambridge, MA) Journal of Guidance, Control, and Dynamics (ISSN 0731-5090), vol. 10, May-June 1987, p. 233-241. refs

It is shown that once-per-orbit modulations of the length of an orbiting tether can be used to modify the eccentricity, energy, and line of apsides orientation of its center of mass while maintaining a constant angular momentum and orbital parameter. Appropriate length variation laws are developed and the effects are quantified and interpreted. Several applications are discussed, including modifications to the orbit of a Space Station, reduction by 30 percent of the Delta-V to launch a satellite to 12 h orbit, and the relocation of the apogee for observation satellites.

A87-40859\*# Harvard-Smithsonian Center for Astrophysics, Cambridge, Mass.

#### A THREE-MASS TETHERED SYSTEM FOR MICRO-G/VARIABLE-G APPLICATIONS

ENRICO C. LORENZINI (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA) (Guidance, Navigation and Control Conference, Williamsburg, VA, Aug. 18-20, 1986, Technical Papers, p. 97-105) Journal of Guidance, Control, and Dynamics (ISSN) 0731-5090), vol. 10, May-June 1987, p. 242-249. Previously cited in issue 23, p. 3425, Accession no. A86-47413. refs (Contract NAS8-36606)

#### A87-41430

#### A POLAR PLATFORM FOR THE REMOTE SENSING NEEDS OF ECOLOGY AND AGRICULTURE - A VIEW FROM THE U.K. P. J. CURRAN and S. E. PLUMMER (Sheffield, University, International Journal of Remote Sensing (ISSN 0143-1161), vol. 8, April 1987, p. 555-567. refs

(Contract NERC-P60/G6/16)

The main characteristics of the proposed polar-orbiting remote sensing satellites to be implemented in the Space Station program are described. The potential benefits of the polar platforms to remote sensing are discussed. The remote sensing needs of UK scientists in the areas of ecology and agriculture are examined.

#### A87-42585\* Massachusetts Inst. of Tech., Cambridge. THE RADIATION IMPEDANCE OF AN ELECTRODYNAMIC **TETHER WITH END CONNECTORS**

DANIEL E. HASTINGS and J. WANG (MIT, Cambridge, MA) Geophysical Research Letters (ISSN 0094-8276), vol. 14, May 1987, p. 519-522. refs (Contract NAG3-695)

Electrodynamic tethers are wires deployed across the earth's geomagnetic field through which a current is flowing. The radiation impedance of a tether with end connectors carrying an ac current is computed from classical antenna theory. This simulates the use of a tether on a space structure. It is shown that the current flow pattern at the tether connector is critical to determining the overall radiation impedance. If the tether makes direct electrical contact with the ionosphere then radiation impedances of the order of several thousand Ohms can be expected. If the only electrical contact is through the end connectors then the impedance is only a few Ohms for a dc current rising to several tens of Ohms for an ac current with frequencies in the whistler range.

A87-43154\* National Aeronautics and Space Administration. Washington, D.C.

### THE EVOLUTION OF THE GEOSTATIONARY PLATFORM

BURTON I. EDELSON, ROBERT R. LOVELL, and C. LOUIS CUCCIA (NASA, Office of Space Science and Applications, Washington, DC) IEEE Journal on Selected Areas in Communications (ISSN 0733-8716), vol. SAC-5, May 1987, p.

The paper will review the conceptual development over the last decade of the use of very large spacecraft, i.e., 'platforms', in geostationary orbit. Geostationary platforms were originally conceived as an efficient means of increasing the capacity at a point in the geostationary orbital arc. Also, geostationary platforms

have been suggested for mounting very large antennas as will be required for mobile communications, or high power sources as will be required for broadcast services to small terminals. More recently these 'large satellite' platforms were also envisioned as including earth observation and other science payloads. The advent of the Space Station, which can provide a staging base for platform assembly and test in space at low earth orbit prior to launch to geostationary earth orbit, will introduce a new dimension to practical platform design. This paper describes the evolution of concepts for geostationary platforms over the last decade based on both communications and science user scenarios developed worldwide.

A87-43165\* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

#### AN ADVANCED GEOSTATIONARY COMMUNICATIONS **PLATFORM**

THADDEUS A. HAWKES, WILLIAM CLOPP (RCA, Astro-Space Div., Princeton, NJ), and JACK LEKAN (NASA, Lewis Research Center, Cleveland, OH) IEEE Journal on Selected Areas in Communications (ISSN 0733-8716), vol. SAC-5, May 1987, p. 749-758, refs

A large geostationary communications platform can offer many attractive possibilities for providing lower cost communications. The platform payload concept described in this paper attempts to exploit these possibilities. The use of a combination of spot and wide-area coverage beams accommodates users in both high- and low-density population areas, and provides a good degree of frequency reuse. A standard channel bandwidth, used for most traffic, facilitates interconnectivity among C-, Ku-, and Ka-band users who may all access the platform. Adoption of a 36-MHz channel bandwidth leads to transmission rates that would be easily handled by low-cost terminals providing direct customer premises service. This also lends itself well to a solution using a large number of solid-state power amplifiers operating in all three frequency bands and sharing a common, redundant, conditioned power supply.

#### A PROPOSAL FOR SPACE TETHER DAMAGE INDICATION. LOCATION, AND EVALUATION - THE REPAIR MONKEY

WARREN G. GRECZYN AIAA Student Journal (ISSN 0001-1460), vol. 25, Spring 1987, p. 12-14, 32.

A proposed tether damage location and evaluation technique that uses the Repair Monkey Module (RMM) is described. The theory of conducting tether power generation is discussed. The operation of the RMM to detect and evaluate tether damage is examined. Consideration is given to the configuration, continuous belt drive design, and the video cameras and internal lights (for damage evaluation) of the RMM; diagrams of the RMM configuration and subsystems are provided.

A87-44176\* Jet Propulsion Lab., California Inst. of Tech.,

### REMOTE SENSING; PROCEEDINGS OF THE MEETING.

ORLANDO, FL, APR. 3, 4, 1986
ROBERT T. MENZIES, ED. (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) Meeting sponsored by SPIE. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers (SPIE Proceedings. Volume 644), 1986, 115 p. For individual items see A87-44177 to A87-44187. (SPIE-644)

Advances in optical technology for remote sensing are discussed in reviews and reports of recent experimental investigations. Topics examined include industrial applications, laser diagnostics for combustion research, laser remote sensing for ranging and altimetry, and imaging systems for terrestrial remote sensing from space. Consideration is given to LIF in forensic diagnostics, time-resolved laser-induced-breakdown spectrometry for rapid analysis of alloys, CARS in practical combustion environments, airborne inertial surveying using laser tracking and profiling techniques, earth-resources instrumentation for the EOS polar platform of the Space Station, and the SAR for EOS.

A87-44184\* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

## EARTH RESOURCES INSTRUMENTATION FOR THE SPACE STATION POLAR PLATFORM

MARTIN J. DONOHOE (NASA, Goddard Space Flight Center, Greenbelt, MD) and DEBORAH VANE (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1986, p. 76-81. NOAA-sponsored research.

The spacecraft and payloads of the Space Station Polar Platform program are described in a brief overview. Present plans call for one platform in a descending morning-equator-crossing orbit at 824 km and two or three platforms in ascending afternoon-crossing orbits at 542-824 km. The components of the NASA Earth Observing System (EOS) and NOAA payloads are listed in tables and briefly characterized, and data-distribution requirements and the mission development schedule are discussed. A drawing of the platform, a graph showing the spectral coverage of the EOS instruments, and a glossary of acronyms are provided.

A87-44185\* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

### CONCEPTUAL DESIGN OF THE HIGH-RESOLUTION IMAGING SPECTROMETER (HIRIS) FOR EOS

MARK HERRING (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1986, p. 82-85. refs

The design concept and practical realization of HIRIS, the imaging spectrometer being developed for the Space Station Earth Observation System (EOS) on the basis of the Shuttle Imaging Spectrometer Experiment (SISEX), are discussed. Nominal operating parameters for HIRIS include altitude 705 km, GIFOV 30 m, swath 48.4 km, spectral sampling interval 10 nm, spectral coverage 400-2450 nm, cross-track pointing +20/-20 deg, down-track pointing +60/-30 deg, and raw data rate (at 8 bits/pixel) 621 Mb/s. The f/1.9 optical configuration for HIRIS is shown in a drawing, and consideration is given to technological challenges being encountered in modifying the SISEX focal-plane detectors, data-reduction procedures, and cooling system to meet the HIRIS requirements.

A87-44186\* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

## PRELIMINARY SYSTEM CONCEPTS FOR MODIS - A MODERATE RESOLUTION IMAGING SPECTROMETER FOR EOS

W. L. BARNES, H. OSTROW, and V. V. SALOMONSON (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1986, p. 86-93. refs

Plans are underway at NASA Goddard to develop a moderate-resolution (0.5-1.0-km) imaging spectrometer with 104 spectral bands in the range from 0.4 to 14.2 microns for use as a NASA facility aboard the Space Station Earth Observation System. Science requirements call for the system to image the earth's surface every 2 d for a period of 10 yr, using two electrooptic sensors. MODIS-T (tilt) has 64 10-nm-wide channels in the 400-1000-nm range. The system has 5-cm-diameter optics, scans + or - 45 deg, and can be pointed + or - 60 deg along track. Calculated S/N is in excess of 800:1 near 400 nm. MODIS-N (nadir) scans + or - 45 deg about nadir with 12 500-m- and 28 1000-m-resolution channels, including two polarization channels and 14 thermal-IR channels. With 20-cm-diameter optics the calculated S/N of the majority of the reflected solar bands is over 1000:1. NETD values for the thermal bands are on the order of 0.1-0.2 K at 300 K. Combined MODIS-T and MODIS-N data rates are 8.3 Mb/s in daylight and 1.5 Mb/s at night, resulting in a total of 360 Gb/d.

A87-44187\* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

### THE EARTH OBSERVING SYSTEM (EOS) SYNTHETIC APERTURE RADAR (SAR)

JOBEA CIMINO and DAN HELD (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1986, p. 94-107. refs

The evolution of the Spaceborne Imaging Radar (SIR) has led to a multipolarization, multifrequency SAR with variable imaging geometry which will be ready for flight on the Space Station Earth Observing System (EOS). Nominally, this SAR will be a three-frequency (L-, C-, and X-band) system with quad polarization available for the L and C bands. It will be capable of acquiring multiincidence-angle data using electronic beam steering, and other imaging geometries by mechanically pitching, yawing, and rolling the antenna. The capabilities of the EOS SAR, particularly acquisition of cross-polarized and high-incidence-angle data, depend on the altitude of the platform on which the SAR flies and improve significantly at lower altitudes. The EOS SAR will provide a unique new data set and will play a key role in understanding the earth's global processes, alone and synergistically with other EOS instruments.

## A87-44533\* Perkin-Elmer Corp., Danbury, Conn. OPTICAL ARRAYS FOR FUTURE ASTRONOMICAL TELESCOPES IN SPACE

ALAN N. BUNNER (Perkin-Elmer Corp., Space Science Div., Danbury, CT) IN: Infrared, adaptive, and synthetic aperture optical systems; Proceedings of the Meetings, Arlington, VA, Apr. 8, 1985 and Orlando, FL, Apr. 1, 2, 1986. Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, 1986, p. 180-188. refs (Contract NAS8-36105)

NASA's Marshall Space Flight Center is currently evaluating several advanced optical space telescope concepts for the achievement of both higher sensitivity and greater angular resolution than the Hubble Space Telescope; their designs encompass one- and two-dimensional coherent arrays of mirrors in both focal and afocal configurations. Attention is given to those arrays that appear capable of fabrication and orbital deployment by the year 2005, and to the tradeoff involved between synthetic aperture concepts that furnish high angular resolution and those that yield sensitivity for faint, extended source imaging.

#### A87-50447#

## THE MISSION FUNCTION CONTROL FOR DEPLOYMENT AND RETRIEVAL OF SUBSATELLITE

HIRONORI FUJII and SHINTARO ISHIJIMA (Tokyo Metropolitan Institute of Technology, Japan) IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 1. New York, American Institute of Aeronautics and Astronautics, 1987, p. 395-399. refs (AIAA PAPER 87-2326)

This paper presents a new control algorithm applied to the problem of deployment and retrieval of a subsatellite connected through a tether to the main body. From control theory an idea of the 'mission function' is introduced, which is an index used to describe the concept of the mission. The mission function is defined to be positive definite and to be zero when the given mission is completed. The deployment and retrieval is thus controlled to decrease the mission function. The control law is totally different from the control laws that have been presented in the literature; linearity and simple open-loop control are not assumed. In addition the present theory can be applied equally to both the deployment and the retrieval cases. A simplified model is used to clarify the fundaments of the problem, only in-plane motion is treated and neither flexibility nor air drag is included. Results of numerical simulation show an excellent controlled behavior.

A87-50750\*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

### AN ASTROMETRIC FACILITY FOR PLANETARY DETECTION ON THE SPACE STATION

KENJI NISHIOKA, JEFFREY D. SCARGLE, and JOHN J. GIVENS (NASA, Ames Research Center, Moffett Field, CA) International Symposium on Optical and Optoelectronic Applied Science Engineering, 4th, The Hague, Netherlands, Mar. 28-Apr. 3, 1987, Paper. 13 p. refs

The preliminary system definition study for an Astrometric Telescope Facility (ATF) designed for the Space Station IOC is discussed, and a strawman system is designed which is found to meet the requirements for extrasolar planetary systems search and study. The strawman facility design, with a prime-focus 1.25-m aperture telescope and an f ratio of 13, was selected to minimize random and systematic errors. A basic operations approach is identified, including the approach to launch, initial on-orbit assembly and checkout, normal operations, and the response to anomolous conditions or failures. The preliminary system is designed to be fail-safe and single-fault tolerant. Mission analysis indicates that the basic viewing required for planetary detection can be accomplished in about 2/3 of the total viewing time.

#### A87-52450\* Naples Univ. (Italy).

## THE TETHERED SATELLITE SYSTEM FOR LOW DENSITY AEROTHERMODYNAMICS STUDIES

GIOVANNI M. CARLOMAGNO, LUIGI DE LUCA (Napoli, Universita, Naples, Italy), P. M. SIEMERS, III, and GEORGE M. WOOD, JR. (NASA, Langley Research Center, Hampton, VA) Unione Italiana de Termofluidodinamica, Congresso Nazionale sulla Trasmissione del Calore, 4th, Genoa, Italy, June 5-7, 1986, Paper. 15 p. refs (Contract CNR-PSN-84-048; CNR-PSN-85-082)

The feasibility of the operation of the Tethered Satellite System (TSS) as a continuous open wind tunnel for low-density aerothermodynamic studies (applicable to the design of hypersonic space vehicles including STARFAC, AOTV, and ERV) is considered. The Shuttle Continuous Open Wind Tunnel (SCOWT) program, for the study of the energy and momentum transfer between the tethered satellite and its environmental medium during the TSS/2 mission, is described. Instrumentation and TSS design requirements to meet SCOWT objectives are also considered. SCOWT will provide information on the gasdynamic processes occurring downstream of the bow wave standing in front of the TS, the chemistry and physics of the upper atmosphere related to satellite aerothermodynamics, and TSS's overall experimental envelope of operation.

**A87-53002\*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

## SPACE STATION GAS-GRAIN SIMULATION FACILITY - APPLICATION TO EXOBIOLOGY

C. P. MCKAY, C. R. STOKER (NASA, Ames Research Center, Moffett Field CA), J. MORRIS, G. CONLEY (Colorado, University, Boulder), and D. SCHWARTZ (SETI Institute, Los Altos, CA) (COSPAR, Plenary Meeting, 26th, Topical Meeting and Workshop 4 on Life Sciences and Space Research XXII/2/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 12, 1986, p. 195-206. refs

The technical issues involved in performing experiments on the behavior and properties of aerosols in a microgravity environment provided by the Space Station are reviewed. The displacement of a particle resulting from g-jitter for ballistic, Knudsen, and Stokes flow regimes is examined in detail, and the radiation, acoustic, electrostatic, and electromagnetic mechanisms for the control of this motion are described. The simulation of organic haze production on Titan has been selected as an example experiment for detailed study. The purpose of this experiment was to simulate the photolysis of methane and the subsequent formation of the organic haze particles in the Titan upper atmosphere. B.J.

#### A87-53149

## OPERATIONAL INSTRUMENTS ON THE SPACE STATION-POLAR PLATFORMS - CONTRIBUTIONS BY NOAA AND THE INTERNATIONAL COMMUNITY

BRUCE H. NEEDHAM (NOAA, National Environmental Satellite, Data and Information Service, Washington, DC) IN: IGARSS '87 - International Geoscience and Remote Sensing Symposium, Ann Arbor, MI, May 18-21, 1987, Digest. Volume 1 . New York, Institute of Electrical and Electronics Engineers, Inc., 1987, p. 387-392.

In the mid-1990's, the National Aeronautics and Space Administration (NASA) and the European Space Agency (ESA) will combine efforts to launch the Space Station along with two orbiting Polar Platforms. The National Oceanic and Atmospheric Administration (NOAA) will be utilizing the NASA and ESA Polar Platforms to carry its operational instruments for environmental remote sensing as a logical follow on to the current series which ends with the NOAA-K, L, M satellites. This paper will describe the operational instruments that NOAA proposes to fly on the two Polar Platforms, and other international contributions that are under consideration.

#### A87-54197

#### **INFRA-RED ASTRONOMY AFTER IRAS**

JOHN K. DAVIES (Royal Observatory, Edinburgh, Scotland) Space (ISSN 0267-954X), vol. 3, July-Aug. 1987, p. 20-24.

A number of performed and proposed space astronomy missions are discussed. The IRAS mission which mapped almost the entire sky at wavelengths of 12, 25, 60, and 100 microns detecting 250,000 IR sources and the Spacelab-2 IR telescope which observed about 90 percent of the sky per orbit are examined. Consideration is given to the design and objectives of the proposed ESA Cosmic Background Explorer mission and the IR Space Observatory, the U.S. Space IR Telescope Facility, and the Soviet Aelita mission. The development of the Far IR Space Telescope, which is to be an 8-m antenna for submm astronomy, and the Large Deployable Reflector, a 12-15-m orbiting telescope for the 2 micron to 1 mm range, is being studied.

#### A87-54198

## DEVELOPING SPACE STATION. II - POWER, RENDEZVOUS, DOCKING AND REMOTE SENSING ARE IMPORTANT ELEMENTS OF THE SPACE STATION

ROY HATHAWAY Space (ISSN 0267-954X), vol. 3, July-Aug. 1987, p. 35-37, 48.

Some systems and applications for the proposed Space Station are considered. The use of GaAs cells in the solar power systems for the Space Station is examined; the fabrication, characteristics, and costs of GaAs solar cells are described. Rendezvous and docking capabilities are required for the Space Station to function as a polar platform; a monopulse tracking radar is being evaluated as the docking system for the Station. The benefits the Space Station, operating as a polar platform, can provide to remote sensing, in particular meteorology, environmental research, and solar terrestrial physics, are discussed.

N87-20359# MATRA Espace, Toulouse (France). Dept. of Satellite Engineering.

#### QUALIFICATION OF THE FAINT OBJECT CAMERA

PATRICE AMADIEU *In* AGARD Mechanical Qualification of Large Flexible Spacecraft Structures 13 p Jul. 1986 Avail: NTIS HC A12/MF A01

The Faint Object Camera (FOC) is presently integrated as one of the five Scientific Instruments in the NASA Space Telescope (ST) which after an extensive integration and tests campaign should be launched in 1986. The Space Telescope is an observatory of 13 metres long, 4.3 metres diameter and 11,000 kilogrammes which will be placed by the Space Shuttle in a 500 kms circular orbit. The Faint Object Camera installed at the ST focal plane is a complex instrument with a total weight of 320 kgs and overall dimensions 1 x 1 x 2.2 metres. A Structural/Thermal Model (STM) and flight model of the FOC have been built. The FOC/STM was subjected to an extensive test program with for the mechanical part, sine and random vibrations, acoustic noise and modal test.

On the FOC/PFM, acoustic noise only was applied for workmanship verification. With the FOC integrated now in the Space Telescope, and considering the specimen overall dimensions, limited mechanical testing will be applied at ST level which will consist of modal survey and acoustic noise. Then at the end of the test program, the overall assembly will be shipped to Kenndey Space Center and launched.

N87-20621# European Space Agency, Paris (France).
PROCEEDINGS OF THE EUROPEAN SYMPOSIUM ON POLAR
PLATFORM OPPORTUNITIES AND INSTRUMENTATION FOR
REMOTE-SENSING (ESPOIR)

E. J. ROLFE, ed. and B. BATTRICK, ed. Nov. 1986 127 p Symposium held in Avignon, France, 16-18 Jun. 1986 (ESA-SP-266; ISSN-0379-6566; ETN-87-99434) Avail: NTIS HC

European activities in preparing the Columbus polar platforms; United States cooperation with Europe; atmosphere, land, ocean/ice, and solid Earth missions; and platform instruments, calibrating, data management, orbit configuration, and servicing were discussed.

ESA

N87-20622# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

THE EARTH OBSERVATION ACTIVITIES OF THE EUROPEAN SPACE AGENCY AND THE USE OF THE POLAR PLATFORM OF THE INTERNATIONAL SPACE STATION

B. PFEIFFER In its Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-sensing (ESPOIR) p 7-10 Nov. 1986

Avail: NTIS HC A07/MF A01

The Meteosat, ERS-1, and Earthnet programs are reviewed. The long term follow-on programs are outlined. Space infrastructure elements of ESA and their use for Earth observation are described. User requirements and ESA policy for a polar Earth observations platform are discussed.

N87-20625# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

WORKING GROUP ON EARTH OBSERVATION REQUIREMENTS FOR THE POLAR ORBITING PLATFORM ELEMENTS OF THE INTERNATIONAL SPACE STATION (THE POPE WORKING GROUP)

N. DEVILLIERS *In its* Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-sensing (ESPOIR) p 29-33 Nov. 1986

Avail: NTIS HC A07/MF A01

A polar platform specification for Earth observations was defined. It features 2 platforms in coordinated Sun-synchronous orbits at an altitude of 800 km (morning and afternoon orbits); a multidisciplinary payload divided between the platforms growing from 2.4 tons initially (per platform) through 3.6 tons at the first servicing to a mature amount of 4.8 tons per platform at the second service point; and servicing every 2 to 3 yr, adding new payloads and upgrading payloads. The power requirements grow from 2 to 2.5 KW initially, through 4 KW, to 6 KW. The data rates of up to several hundred megabits per second are compatible with: direct downlinking, and the proposed European Data Relay Satellite System; the lower data rates generated globally are compatible with on-board recording techniques.

N87-20631# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

COOPERATION OF THE INTERNATIONAL SPACE STATION PARTNERS IN THE PREPARATION OF THE USE OF SPACE STATION ELEMENTS FOR EARTH OBSERVATION (PLATFORM AND PAYLOAD ASPECTS)

B. PFEIFFER In its Proceedings of the European Symposium on

Polar platform Opportunities and Instrumentation for Remote-sensing (ESPOIR) p 65-67 Nov. 1986 Avail: NTIS HC A07/MF A01

Space station elements and launch/services means for polar missions are discussed. European interests are identified. Items for further study and coordination between space station partners are suggested. Potential polar platform instruments, and their providers, are listed.

N87-20634# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).

LAND PANEL REPORT

J. BODECHTEL and F. LANZL In ESA Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-sensing (ESPOIR) p 79-83 Nov. 1986

Avail: NTIS HC A07/MF A01

International Space Station polar platform sensor configurations and missions are suggested. The platforms should maintain the capability for operational land remote sensing using optical sensors; improve the capability of optical sensors in terms of radiometric and spatial resolution, coverage, stereoscopic capability, etc.; improve experimental capabilities for allweather remote sensing of land with microwave sensors, to provide an operational capability similar to that of optical sensors; optimize the integration of microwave and optical data; set up demonstration programs in renewable resources, achieve operational status in the 1990s; and promote fundamental research activities.

N87-20841\*# National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.

## AN ASTROMETRIC FACILITY FOR PLANETARY DETECTION ON THE SPACE STATION

KENJI NISHIOKA, JEFFREY D. SCARGLE, and JOHN J. GIVENS Apr. 1987 16 p Presented at the 4th International Symposium on Optical and Optoelectronic Applied Science Engineering, The Hague, Netherlands, 28 Mar. - 3 Apr. 1987

(NÃSA-TM-89436; A-87133; NAS 1.15:89436) Avail: NTIS HC A02/MF A01 CSCL 03A

An Astrometric Telescope Facility (ATF) for planetary detection is being studied as a potential space station initial operating capability payload. The primary science objective of this mission is the detection and study of planetary systems around other stars. In addition, the facility will be capable of other astrometric measurements such as stellar motions of other galaxies and highly precise direct measurement of stellar distance within the Milky Way Galaxy. The results of a recently completed ATF preliminary systems definition study are summarized. Results of this study indicate that the preliminary concept for the facility is fully capable of meeting the science objective without the development of any new technologies. A simple straightforward operations approach was developed for the ATF. A real-time facility control is not normally required, but does maintain a near real-time ground monitoring capability for the facility and science data stream on a full-time basis. Facility observational sequences are normally loaded once a week. In addition, the preliminary system is designed to be fail-safe and single-fault tolerant. Routine interactions by the space station crew with the ATF will not be necessary, but onboard controls are provided for crew override as required for emergencies and maintenance.

N87-21973# Joint Publications Research Service, Arlington, Va. STATUS OF ORBITAL ASTRONOMY PROJECTS

YE. NELEPO In its USSR Report: Space (JPRS-USP-87-001) p 11-12 19 Feb. 1987 Transl. into ENGLISH from Trud (Moscow, USSR), 25 Oct. 1986 p 3

Avail: NTIS HC A11/MF A01

Plans for orbiting spacecraft with telescopes for radio, gamma-ray, and X-ray astronomy are reported. One radio astronomy project involves an interferometric system of interactive ground and space telescopes. An X-ray observatory is being developed for the orbiting station Mir. Granat, an orbiting

observatory, will measure hot plasmas in clusters of galaxies, X-ray pulsars, and regions surrounding black holes. B.G.

N87-22457\*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

PROBLEMS IN MERGING EARTH SENSING SATELLITE DATA SETS

PAUL H. SMITH and MICHAEL J. GOLDBERG Mar. 1987 15

(NASA-TM-87820; REPT-8780275; NAS 1.15:87820) Avail: NTIS HC A02/MF A01 CSCL 12B

Satellite remote sensing systems provide a tremendous source of data flow to the Earth science community. These systems provide scientists with data of types and on a scale previously unattainable. Looking forward to the capabilities of Space Station and the Earth Observing System (EOS), the full realization of the potential of satellite remote sensing will be handicapped by inadequate information systems. There is a growing emphasis in Earth science research to ask questions which are multidisciplinary in nature and global in scale. Many of these research projects emphasize the interactions of the land surface, the atmosphere, and the oceans through various physical mechanisms. Conducting this research requires large and complex data sets and teams of multidisciplinary scientists, often working at remote locations. A review of the problems of merging these large volumes of data into spatially referenced and manageable data sets is presented.

Author

N87-22508\*# Alabama Univ., Huntsville. College of Science. INVESTIGATION OF BEAM-PLASMA INTERACTIONS Final Report

RICHARD C. OLSEN May 1987 29 p (Contract NAG3-620)

(NASA-CR-180579; NAS 1.26:180579) Avail: NTIS HC A03/MF A01 CSCL 20I

Data from the SCATHA satellite was analyzed to solve the problems of establishing electrical contact between a satellite and the ambient plasma. The original focus of the work was the electron gun experiments conducted near the geosynchronous orbit, which resulted in observations which bore a startling similarity to observations of the SEPAC experiments on SPACELAB 1. The study has evolved to include the ion gun experiments on SCATHA, a modest laboratory effort in hollow cathode performance, and preparation for flight experiments pertinent to tether technology. These areas are addressed separately.

N87-22509\*# Smithsonian Astrophysical Observatory, Cambridge, Mass

INVESTIGATION OF PLASMA CONTACTORS FOR USE WITH ORBITING WIRES Semiannual Report, 1 Jul. - 31 Dec. 1986 ROBERT D. ESTES Jun. 1987 20 p

(Contract NAG9-126)

(NASA-CR-180922; NAS 1.26:180922; SAR-2) Avail: NTIS HC A02/MF A01 CSCL 20I

The effort to determine the size and shape of the hollow cathode cloud emitted from an orbiting system was continued. In addition, the results obtained for the ionospheric wave impedance of a tethered system was applied to the experiments under consideration. The recent plasma chamber experimental results reported by Urrutia and Stenzel are still being considered. The problem is being studied as to how the ionospheric plasma's global response to the moving disturbance presented by the electrodynamic tethered satellite system affects the system's ability to function as a power generator or thruster.

N87-22570\*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ASTRONOMIC TELESCOPE FACILITY: PRELIMINARY SYSTEMS DEFINITION STUDY REPORT. VOLUME 2: TECHNICAL DESCRIPTION

CHARLIE SOBECK, ed. May 1987 400 p

(NASA-TM-89429-VOL-2; A-87172; NAS 1.15:89429-VOL-2)

Avail: NTIS HC A17/MF A01 CSCL 03A

The Astrometric Telescope Facility (AFT) is to be an earth-orbiting facility designed specifically to measure the change in relative position of stars. The primary science investigation for the facility will be the search for planets and planetary systems outside the solar system. In addition the facility will support astrophysics investigations dealing with the location or motions of stars. The science objective and facility capabilities for astrophysics investigations are discussed.

N87-22571\*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

## ASTROMETRIC TELESCOPE FACILITY PRELIMINARY SYSTEMS DEFINITION STUDY. VOLUME 1: EXECUTIVE SUMMARY

CHARLIE SOBECK Mar. 1987 61 p (NASA-TM-89429-VOL-1; A-87113; NAS 1.15:89429-VOL-1) Avail: NTIS HC A04/MF A01 CSCL 03A

The Astrometric Telescope Facility (ATF) is a spaceborne observatory proposed for use on the Space Station (SS) as an Initial Operating Capability (IOC) payload. The primary objective of the ATF will be the search for extrasolar planetary systems and a detailed investigation of any discovered systems. In addition, it will have the capability of conducting other astrophysics investigations; e.g., measuring precise distances and motions of stars within our galaxy. The purposes of the study were to: (1) define mission and system requirements; (2) define a strawman system concept for the facility at the Prephase A level: (3) define the need for additional trade studies or technology development; and (4) estimate program cost for the strawman concept. It has been assumed for the study that the ATF will be a SS payload, will use a SS-provided Coarse Pointing System (CPS), will meet SS constraints, and will make maximum use of existing flight qualified designs or designs to be qualified by the SS program for general SS use.

N87-22756# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

### OPTIMAL SHUTTLE ALTITUDE CHANGES USING TETHERS M.S. Thesis

ROBERT R. FISHER Dec. 1986 64 p

(AD-A179205; AFIT/GA/AA/86D-5) Avail: NTIS HC A04/MF A01 CSCL 22A

The use of tethers in space has been proposed for many years. While much work has been done recently on the use of tethers for towed satellites from the Space Shuttle, little has been done to determine the possible benefits of using tethers as propulsive devices to supplement or replace rocket engines for boost from Low Earth Orbit. Orbit insertion parameters such as velocity and final altitude for the space shuttle are limited by operational constraints on the possible delta V that can be supplied from the engines. The possibility of increasing the performance of the shuttle exists in using an inter-connecting tether to serve as a momentum transfer device between the External Tank and the Shuttle. This added momentum would widen the possible orbit options presently available by boosting the shuttle to a higher orbit. This project derives the equations of motion for a three-body connected dynamical system to include the Shuttle, the external tank, and the cable in orbit around a spherical Earth. Due to current material limitations the tether length will be limited to 100 kilometers. The possible envelope of orbital changes is investigated.

N87-24258\*# National Aeronautics and Space Administration.
Goddard Space Flight Center, Greenbelt, Md.
HIGH ENERGY GAMMA RAY ASTRONOMY

CARL E. FICHTEL *In its* Essays in Space Science p 227-274 Jun. 1987

Avail: NTIS HC A18/MF A01 CSCL 03A

High energy gamma ray astronomy has evolved with the space age. Nonexistent twenty-five years ago, there is now a general sketch of the gamma ray sky which should develop into a detailed picture with the results expected to be forthcoming over the next decade. The galactic plane is the dominant feature of the gamma

ray sky, the longitude and latitude distribution being generally correlated with galactic structural features including the spiral arms. Two molecular clouds were already seen. Two of the three strongest gamma ray sources are pulsars. The highly variable X-ray source Cygnus X-3 was seen at one time, but not another in the 100 MeV region, and it was also observed at very high energies. Beyond the Milky Way Galaxy, there is seen a diffuse radiation, whose origin remains uncertain, as well as at least one quasar, 3C 273. Looking to the future, the satellite opportunities for high energy gamma ray astronomy in the near term are the GAMMA-I planned to be launched in late 1987 and the Gamma Ray Observatory, scheduled for launch in 1990. The Gamma Ray Observatory will carry a total of four instruments covering the entire energy range from 30,000 eV to 3 x 10 to the 10th eV with over an order of magnitude increase in sensitivity relative to previous satellite instruments.

## N87-25033# Open Univ., Oxford (England). IDEAS FOR EDUCATIONAL PHYSICS EXPERIMENTS IN SPACE

DAVID A. BLACKBURN In ESA Proceedings of the GIREP Conference 1986. Cosmos: An Educational Challenge p 43-46

Avail: NTIS HC A20/MF A01

Spaceborne demonstrations dealing with centers of mass, convection, conservation of angular and linear momentum, and quantitative experiments concerning fluid motion, Keplerian orbits, and human body movements are suggested. Possible student groups (from astronauts to the general public) are indicated.

**ESA** 

# N87-25351# Army Military Personnel Center, Alexandria, Va. THERMAL AND DYNAMICAL EFFECTS ON ELECTRODYNAMIC SPACE TETHERS Final Report JOHN S. PRALL, JR. 8 May 1987 139 p

JOHN S. PRALL, JR. 8 May 1987 139 p (AD-A180276) Avail: NTIS HC A07/MF A01 CSCL 10A

Electrodynamic tethers are essentially long conducting wires which, when deployed from an orbiting satellite, can generate power by converting orbital mechanical energy into electrical energy for use on the satellite. An analytical and numerical analysis was carried out on the operation of an electrodynamic tether system used for power generation and/or thrusting in a space environment. Three problems were examined. First, the efficiency of an uninsulated tether of prescribed design, as determined by the magnitude of current leakage along its length due to positive ion capture and secondary electron emissions, was compared to that of a perfectly insulated tether of identical design. Second, the effects on system efficiency of variations in the design parameters of the tether and the orbit in which it operates were examined by means of a numerical analysis of the thermal balance of the system. Third, the effects which the mode of operation of the tether has on the classical elements of the orbit in which it operates were examined through a numerical analysis.

N87-25506 Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Space Systems Group.

THE RADARSAT MODULAR OPTO-ELECTRONIC

THE RADARSAT MODULAR OPTO-ELECTRONIC MULTISPECTRAL SCANNER (R-MOMS): A POTENTIAL CANDIDATE FOR THE POLAR ORBITING PLATFORM (POP) ALSO

D. MEISSNER and H. L. WERSTIUK 1986 11 p Presented at the 37th International Astronautical Federation Congress on Space: New Opportunities for All People, innsbruck, Austria, 4-11 Oct. 1986 Previously announced in IAA as A87-15855 Submitted for publication

(MBB-UR-873/86; IAF-86-81; ETN-87-99936) Avail: Issuing Activity

The design and performance characteristics of the Radarsat opto-electronic scanner (R-MOMS) are outlined, and its use on the Polar Orbiting Platform (POP) is proposed. The R-MOMS consists of 4 spectral channels with center wavelengths 0.485, 0.555, 0.650, and 0.825 microns, with 13,500 usable pixels. Strip

width is 405 km, with a ground pixel size of 60, 30, 30, and 30 m for the 4 bands. For POP, an along-track stereo mode can be added.

N87-25560# National Oceanic and Atmospheric Administration, Washington, D. C. Special Projects Div.

### PLANNING FOR FUTURE OPÉRATIONAL SENSORS AND OTHER PRIORITIES

JAMES C. FISCHER, ed., WALTER PLANET, LARRY STOWE, and WILLIAM L. SMITH Jun. 1987 50 p (NOAA-NESDIS-30) Avail: NTIS HC A03/MF A01

The study programs established by the National Environmental Satellite, Data, and Information Service (NESDIS) Office of Systems Development for polar orbiting and geostationary platform sensors are defined. The main thrust of the studies is to prepare an operational payload for the polar platform portion of the space station program. The Advanced Medium Resolution Infrared Radiometer (AMRIR) will be a replacement for the Advanced Very High Resolution Radiometer (AVHRR) and the High Resolution Infrared Radiometer Sounder (HIRS), now operational on the NOAA series of polar orbiters. The Global Ozone Monitoring Radiometer (GOMR) will replace the Solar Backscatter Ultraviolet (SBUV) on the polar platform as the operational ozone monitor. A series of geostationary environmental satellites, beginning with GOES-I, will offer improved image products and operate the first operational sounder from a geostationary satellite. Plans directed towards the development of other sensors are discussed and programs to support microwave science investigations are described.

N87-25767\*# Colorado Univ., Boulder. Dept. of Aerospace Engineering Sciences.

## A METHOD OF VARIABLE SPACING FOR CONTROLLED PLANT GROWTH SYSTEMS IN SPACEFLIGHT AND TERRESTRIAL AGRICULTURE APPLICATIONS

J. KNOX Oct. 1986 20 p (Contract NCC2-210)

(NASA-CR-177447; NAS 1.26:177447) Avail: NTIS HC A02/MF A01 CSCL 06K

A higher plant growth system for Controlled Ecological Life Support System (CELSS) applications is described. The system permits independent movement of individual plants during growth. Enclosed within variable geometry growth chambers, the system allocates only the volume required by the growing plants. This variable spacing system maintains isolation between root and shoot environments, providing individual control for optimal growth. The advantages of the system for hydroponic and aeroponic growth chambers are discussed. Two applications are presented: (1) the growth of soybeans in a space station common module, and (2) in a terrestrial city greenhouse.

N87-26083\*# Smithsonian Astrophysical Observatory, Cambridge Mass.

#### ANALYTICAL INVESTIGATION OF THE DYNAMICS OF TETHERED CONSTELLATIONS IN EARTH ORBIT, PHASE 2 Quarterly Report No. 9, 1 Apr. - 30 Jun. 1987

ENRICO C. LORENZINI Jul. 1987 56 p

(Contract NAS8-36606)

(NASA-CR-179149; NAS 1.26:179149) Avail: NTIS HC A04/MF A01 CSCL 22B

A control law was developed to control the elevator during short-distance maneuvers along the tether of a 4-mass tethered system. This control law (called retarded exponential or RE) was analyzed parametrically in order to assess which control parameters provide a good dynamic response and a smooth time history of the acceleration on board the elevator. The short-distance maneuver under investigation consists of a slow crawling of the elevator over the distance of 10 m that represents a typica maneuver for fine tuning the acceleration level on board the elevator. The contribution of aerodynamic and thermal perturbations upon acceleration levels was also evaluated and acceleration levels obtained when such pertubations are taken into account were compared to those obtained by neglecting the thermal and aerodynamic forces. In addition, the preparation of a tether

simulation questionnaire is illustrated. Analytic solutions to be compared to numerical cases and simulator test cases are also discussed.

N87-26174\*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

#### REVIEW OF LOW EARTH ORBITAL (LEO) FLIGHT **EXPERIMENTS**

LEGER, B. SANTOSMASON, J. VISENTINE, and J. MINECZ In Jet Propulsion Lab., Proceedings of the NASA Workshop on Atomic Oxygen Effects p 1-10 1 Jun. 1987 Avail: NTIS HC A09/MF A01 CSCL 22A

The atomic oxygen flux exposure experiments flown on Space Shuttle flights STS-5 and STS-8 are described along with the results of measurements made on hardware returned from the Solar Maximum repair mission (Space Shuttle flight 41-C). In general, these experiments have essentially provided for passive exposure of samples to oxygen fluences of approximately 1 to 3.5 x 10(20) atoms/sq cm. Atmospheric density is used to derive fluence and is dependent on solar activity, which has been on the decline side of the 11-year cycle. Thus, relatively low flight altitudes of less than 300 km were used to acquire these exposures. After exposure, the samples were analyzed using various methods ranging from mass loss to extensive scanning electron microscopy and surface analysis techniques. Results are summarized and implications for the space station are discussed.

N87-26188\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

#### NEUTRAL ATOMIC OXYGEN BEAM PRODUCED BY ION CHARGE EXCHANGE FOR LOW EARTH ORBITAL (LEO) SIMULATION

BRUCE BANKS, SHARON RUTLEDGE, MARKO BRDAR, CARL OLEN, and CURT STIDHAM (Cleveland State Univ., Ohio.) Jet Propulsion Lab., Proceedings of the NASA Workshop on Atomic Oxygen Effects p 127-134 1 Jun. 1987 Avail: NTIS HC A09/MF A01 CSCL 07D

A low energy neutral atomic oxygen beam system was designed and is currently being assembled at the Lewis Research Center. The system utilizes a 15 cm diameter Kaufman ion source to produce positive oxygen ions which are charge exchange neutralized to produce low energy (variable from 5 to 150 eV) oxygen atoms at a flux simulating real time low Earth orbital conditions. An electromagnet is used to direct only the singly charged oxygen ions from the ion source into the charge exchange cell. A retarding potential grid is used to slow down the oxygen ions to desired energies prior to their charge exchange. Cryogenically cooled diatomic oxygen gas in the charge exchange cell is then used to transfer charge to the oxygen ions to produce a neutral atomic oxygen beam. Remaining non-charge exchanged oxygen ions are then swept from the beam by electromagnetic or electrostatic deflection depending upon the desired experiment configuration. The resulting neutral oxygen beam of 5 to 10 cm in diameter impinges upon target materials within a sample holder fixture that can also provide for simultaneous heating and UV exposure during the atomic oxygen bombardment.

N87-26191\*# Vanderbilt Univ., Nashville, Tenn. Dept. of Physics and Astronomy.

#### THE PRODUCTION OF LOW-ENERGY NEUTRAL OXYGEN **BEAMS BY GRAZING-INCIDENCE NEUTRALIZATION Abstract** Only

R. G. ALBRIDGE, R. F. HAGLUND, N. H. TOLK, and A. F. DAECH (Martin Marietta Aerospace, New Orleans, La.) In Jet Propulsion Lab., Proceedings of the NASA Workshop on Atomic Oxygen Effects p 155 1 Jun. 1987

Avail: NTIS HC A09/MF A01 CSCL 07D

The Vanderbilt University neutral oxygen facility produces beams of low-energy neutral oxygen atoms by means of grazing-incidence collisions between ion beams and metal surfaces. Residual ions are reflected by applied electric fields. This method can utilize initial ion beams of either O(+) or O2(+) since a very large percentage of molecular oxygen ions are dissociated when they

undergo grazing-incidence neutralization. The method of neutralization is applicable to low-energy beams and to all ions. Particular emphasis is on O and N2 beams for simulation of the low Earth orbit space environment. Since the beam is a pure O-neutral beam and since measurements of the interaction of the beam with solid surfaces are made spectroscopically, absolute reaction rates can be determined. The technique permits the beams to be used in conjunction with electron and photon irradiation for studies of synergistic effects. Comparisons of optical spectra of Kapton excited by 2.5-keV O, O(+), and O2(+) show significant differences. Optical spectra of Kapton excited by neutral oxygen beams of less than 1 keV have been recorded.

N87-26449\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

#### **ELECTRODYNAMIC TETHER**

MICHAEL PATTERSON In its Space Photovoltaic Research and Technology 1986. High Efficiency, Space Environment and Array Technology p 343 Jun. 1987

Avail: NTIS HC A16/MF A01 CSCL 22B

Electrodynamic tethers hold promise for a variety of space applications. Electrodynamic tethers depend upon the interactions between a moving insulated conductor and the Earth's magnetic field. An electric field is generated along the tether as in a conductor moving in the magnetic field of a generator. If the circuit is closed to the ambient space plasma via a plasma gun or other equivalent device, a current is enabled to flow in the tether, and electric power is generated at the expense of orbital mechanical energy. The net effect is a decrease in the altitude of the orbiting tethered system. The situation can be reversed by driving current against the electric field via an external power supply such as a photovoltaic

N87-26967# Systems Science and Software, La Jolla, Calif. DOCUMENTATION FOR THE SHADO PARTICLE WAKE ROUTINE Technical Report, Oct. 1986 - Jan. 1987

D. L. PETERKA and I. KATZ Jan. 1987 25 p.

(Contract F19668-86-C-0056)

(AD-A181531; SSS-R-87-8495; AFGL-TR-87-0042; SR-5) Avail: NTIS HC A02/MF A01 CSCL 22B

This report documents the computational algorithms of the SHADO routine for computing the particle wake behind large spacecraft in low polar orbit. SHADO will replace the existing module for computing particle densities in the POLAR code and achieves a significant improvement in computational speed.

GRA

N87-29585\*# Ball Aerospace Systems Div., Boulder, Colo. PHASE 3 STUDY OF SELECTED TETHER APPLICATIONS IN SPACE. VOLUME 1: EXECUTIVE SUMMARY Final Report Dec. 1986 33 p

(Contract NAS8-36617)

(NASA-CR-179185; NAS 1.26:179185; DPD-665-VOL-1; DR-4-VOL-1) Avail: NTIS HC A03/MF A01 CSCL 22B

A tethered launch assist from the Shuttle for payloads with up to 10,000 kg mass for the mission model and the tethering of a 15,000 kg science platform for the space station were addressed. Also encompassed was the design and cost analysis for a variable g device that could be placed on the tether and allow ultralow g or other types of experiments to be conducted. Numerous tether applications were examined and their theoretical feasibility and technology requirements were assessed.

N87-29591\*# Smithsonian Astrophysical Observatory, Cambridge,

INVESTIGATION OF PLASMA CONTACTORS FOR USE WITH ORBITING WIRES Final Report, 1 Jan. 1986 - 30 Jun. 1987

ROBERT D. ESTES, MARIO D. GROSSI, and ROBERT HOHLFELD Sep. 1987 108 p

(Contract NAG9-126)

(NASA-CR-181422; NAS 1.26:181422) Avail: NTIS HC A06/MF

The proposed Shuttle-based short tether experiments with

hollow cathodes have the potential for providing important data that will not be obtained in long tether experiments. A critical property for hollow cathode effectiveness as a plasma contactor is the cross magnetic field conductivity of the emitted plasma. The different effects of hollow cathode cloud overlap in the cases of motion-driven and battery-driven operation are emphasized. The calculations presented on the size and shape of the hollow cathode cloud improve the qualitative picture of hollow cathodes in low Earth orbit and provide estimates of time constants for establishing the fully-expanded cloud. The magnetic boundary value problem calculations indicate the way in which the magnetic field will effect the shape of the cloud by resisting expansion in the direction perpendicular to the field. The large-scale interactions of the system were also considered. It was concluded that recent plasma chamber experiments by Stenzel and Urrutia do not model an electrodynamic tether well enough to apply the results to tethered system behavior. Orbiting short tether experiments on hollow cathodes will provide critical information on hollow cathode performance and the underlying physics that cannot be obtained any other way. Experiments should be conducted as soon as funding and a suitable space vehicle are available.

N87-29633\*# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Physics.

OXYGEN INTERACTION WITH SPACE-POWER MATERIALS
Annual Report, 1 May 1986 - 30 Apr., 1987

Annual Report, 1 May 1986 - 30 Apr. 1987
T. G. ECK and R. W. HOFFMAN Oct. 1987
16 p

(Contract NAG3-696)

(NASA-CR-181396; NAS 1.26:181396) Avail: NTIS HC A02/MF A01 CSCL 07D

Data from the space shuttle flights have established that many materials experience relatively rapid degradation when exposed to the low Earth orbit ambient atmosphere, which is predominately atomic oxygen. While much was learned from samples flown on the shuttle, laboratory simulations of the shuttle environment are necessary for a detailed understanding of the various interactions which contribute to the observed degradations. These laboratory experiments are particularly important for predicting the deterioration to be expected for materials aboard orbiting power systems, which will be exposed for long periods of time and could have components operating at very high temperatures. By using a mass spectrometer to synchronously detect molecules emitted from the surface as a result of amplitude modulated oxygen ion bombardment, quantum yields were obtained as a function of ion energy. A technique was developed to obtain preliminary yield data by slowly scanning the mass setting of the mass spectrometer; measurements were extended down to zero modulation frequency; yield data was obtained for the insulating materials (Nomex, Kevlar, and Teflon) used in the construction of electrodynamic tethers; a heated sample holder was constructed to investigate the effect of sample temperature on quantum yields; and the instrumentation was developed to observe the mass spectrometer signal as a function of time during and following bombardment of the sample by a brief (approximately 1 millisecond) pulse of ions. Author

#### 16

#### **OPERATIONS SUPPORT**

Includes descriptions of models, analyses and trade studies of maneuvers, performance, Logistics support, and EVA and/or IVA servicing requirements of systems such as the OMV and OTV, and experiments.

#### A87-32006 SPACE STATION EVA SIMULATION DEMONSTRATES ORBITAL ASSEMBLY

CRAIG COVAULT Aviation Week and Space Technology (ISSN 0005-2175), vol. 126, Jan. 26, 1987, p. 60, 61, 63, 65.

An experimental account is presented of a 3 hr work period in

a neutral buoyancy tank being used by McDonnell Douglas Astronautics to study Space Station construction activities. The work period was devoted to examining connecting joints and nodes for truss structures. Safety and activity recording measures implemented for the session are described. Particular note is made of tasks which exacerbated hand fatigue, techniques discovered for facilely assembling utility trays, and methods for quick and precise beam alignment. The simulations provide data for responses to requests for proposals for Space Station projects.

#### A87-32474

### SPACE LAUNCHER UPPER STAGES - DESIGN FOR MISSION VERSATILITY AND/OR ORBITAL OPERATION

R. G. REICHERT (Dornier System GmbH, Friedrichshafen, West Germany) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 1463-1474.

Upper stage concepts for present and future space launchers are considered, with emphasis on the future achievement of mission versatility and economy. A modular design concept is discussed with allows adjustment of the propellant with respect to payload-mass and velocity requirements by selection of the appropriate number of tank-modules for the given mission. Tank-staging can be applied for extreme velocity-requirements, and orbital assembly and refueling techniques are discussed in conjunction with Space Station planning. Future possibilities for reusable OTVs are considered, with application to commercial, geostationary transportation. The economic advantages and facility requirements of a space-based stage operation are also discussed.

#### A87-32543

#### **ON-ORBIT FLUID MANAGEMENT**

RALPH N. EBERHARDT and DALE A. FESTER (Martin Marietta Corp., Denver, CO) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 1995-2005. refs

The operational scenarios, technology status and design drivers for fluid management systems (FMS) for space applications are outlined. The systems are of concern for ground- and space-based vehicles, i.e., the former operating in and out of the atmosphere and the latter in LEO, GEO and/or beyond. The vehicles may be filled and launched, some to return, or may stay in space, such as is to happen with an Orbit Transfer Vehicle (OTV). Estimates are made of the total fuel requirements for the year 2000, and design and safety contraints for interfacing on-orbit hypergolic fuel systems with the Shuttle and Space Station are considered. The discussion centers on FMS operations with a resupply tanker, a Space Station depot and a user system such as the OTV. Attention is given to the options for selections of pressurization, venting, mass gaging and slosh and thermal control systems, and prototype M.S.K. systems under test are described.

#### A87-32612

#### SATELLITE SERVICING LOGISTICS

JOSEPH E. ABEL (Lockheed Missiles and Space Co., Inc., Huntsville, AL) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 13-16, 1986. 17 p. (SAE PAPER 861723)

Current and anticipated satellite servicing logistics tasks in support of commercial, scientific, and military space based operations are addressed. Anticipated quantities of Orbital Replaceable Units and Orbital Replaceable Instruments on the Space Station and the projected multiple fleet of free flyers require that prompt attention to the supportability elements of on-orbit activities be an absolute and immediate priority. Anticipated costs to sustain orbital maintenance, servicing, and support of future free flyers and the Space Station leads to a conclusion that optimum support with reduced costs can best be achieved by standardization and centralization of support facilities. The logistics support elements described herein provide a scenario to achieve the

supportability goals and reduce the overall satellite servicing costs. A preliminary cost analysis as part of this text confirms the need for a consolidated support program.

Author

**A87-32634\*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

## DESIGN AND DEVELOPMENT OF A SPACE STATION PROXIMITY OPERATIONS RESEARCH AND DEVELOPMENT MOCKUP

RICHARD F. HAINES (NASA, Ames Research Center, Moffett Field, CA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 13-16, 1986. 9 p. refs (SAE PAPER 861785)

Proximity operations (Prox-Ops) on-orbit refers to all activities taking place within one km of the Space Station. Designing a Prox-Ops control station calls for a comprehensive systems approach which takes into account structural constraints, orbital dynamics including approach/departure flight paths, myriad human factors and other topics. This paper describes a reconfigurable full-scale mock-up of a Prox-Ops station constructed at Ames incorporating an array of windows (with dynamic star field, target vehicle(s), and head-up symbology), head-down perspective display of manned and unmanned vehicles, voice- actuated 'electronic checklist', computer-generated voice system, expert system (to help diagnose subsystem malfunctions), and other displays and controls. The facility is used for demonstrations of selected Prox-Ops approach scenarios, human factors research (work-load assessment, determining external vision envelope requirements, head-down and head-up symbology design, voice synthesis and recognition research, etc.) and development of engineering design guidelines for future module interiors.

#### A87-32644

**SPACE STATION** 

#### **HUBBLE SPACE TELESCOPE SATELLITE SERVICING**

W. E. JONES (Lockheed Missiles and Space Co., Inc., Huntsville,
 AL) SAE, Aerospace Technology Conference and Exposition,
 Long Beach, CA, Oct. 13-16, 1986. 14 p.
 (SAE PAPER 861796)

The Hubble Space Telescope (HST) is the first satellite designed from the outset to accommodate servicing in space. Astronauts will have access to and be able to replace scientific instruments, guidance sensors, batteries, solar panels, computers, reaction wheels, etc., all configured as orbital replacement units (ORU). The HST outer shell has been fitted with 225 ft of handrails and 31 foot restraint receptacles. ORU fasteners were designed to permit facile disconnection and connection by astronauts wearing bulky spacesuits. Servicing is to be on regular 3 yr intervals, with retrieval and release from the Orbiter bay to take place at the 320 n. mi. operational orbit of the HST. The projected retrieval, link-up, repair and release procedures, hierarchical priority scheduling approach, and space support equipment to be carried on the Orbiter are explored.

## A87-32667\* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. ROLE OF THE MANNED MANEUVERING UNIT FOR THE

C. E. WHITSETT (NASA, Johnson Space Center, Houston, TX) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 13-16, 1986. 18 p. refs (SAE PAPER 861834)

The performance specifications to be realized in the Manned Maneuvering Unit (MMU) for Space Station operations will be the culmination of design efforts which began during the Gemini project. The types of MMUs which have been built and tested over the past two decades are described, including handheld, jet shoe, and initial rigid backpack configurations. Efforts to enhance the control laws and human factors aspects of the Skylab MMU to meet long-duration, flexible use Space Station requirements are summarized, noting the successes and deficiencies with the Shuttle MMU. The design requirements which must be met to allow the Space Station MMU to be used to perform rescue, transportation,

inspection, assembly, contingency, and programmatic missions are explored.

M.S.K.

### A87-32733\* Ball Aerospace Systems Div., Boulder, Colo. RENDEZVOUS AND DOCKING TRACKER

ART J. RAY, SUSAN E. ROSS, and DOUGLAS R. DEMING (Ball Corp., Aerospace Systems Div., Boulder, CO) IN: Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 . San Diego, CA, Univelt, Inc., 1986, p. 109-118. NASA-supported research.

(AAS PAPER 86-014)

A conceptual solid-state rendezvous and docking tracker (RDT) has been devised for generating range and attitude data for a docking vehicle relative to a target vehicle. Emphasis is placed on the approach of the Orbiter to a link with the Space Station. Three laser illuminators ring the optical axis of the lens a directed toward retroreflectors on the target vehicle. Each retroreflector is equipped with a bandpass filter for a designated illumination frequency. Data are collected sequentially over a 20 deg field of view as the range closes to 100-1000 m. A fourth ranging retroreflector 0.3 m from center is employed during close-in maneuvers. The system provides tracking data on motions with 6 deg of freedom, and furnishes 500 msec updates (to be enhanced to 100 msec) to the operator at a computer console.

A87-32743\* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

## USE OF THE ORBITAL MANEUVERING VEHICLE (OMV) FOR PLACEMENT AND RETRIEVAL OF SPACECRAFT AND PLATFORMS

WILLIAM C. SNODDY, WILLIAM E. GALLOWAY, and ARCHIE C. YOUNG (NASA, Marshall Space Flight Center, Huntsville, AL) IN: Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 . San Diego, CA, Univelt, Inc., 1986, p. 303-319. (AAS PAPER 86-041)

This paper describes the Orbital Maneuvering Vehicle (OMV) and its intended role as a key element of NASA's space infrastructure. Status, plans, and operational modes are summarized. Typical mission scenarios supporting the servicing of spacecraft and platforms from both the Shuttle and the Space Station are described. Particular emphasis is placed on the orbital mechanics associated with the placement and retrieval of spacecraft and platforms. For example, the optimum placement of a Space Station co-orbiting spacecraft in order to maximize the time interval during which it can be retrieved by a Space Station based OMV is shown as a function of the ballistic coefficient of the spacecraft.

## A87-32744\* Draper (Charles Stark) Lab., Inc., Cambridge, Mass. AEROASSIST FLIGHT EXPERIMENT GUIDANCE, NAVIGATION AND CONTROL

TIMOTHY J. BRAND (Charles Stark Draper Laboratory, Inc., Cambridge, MA) and ALBERT G. ENGEL IN: Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986. San Diego, CA, Univelt, Inc., 1986, p. 321-334. NASA-supported research. refs

(AAS PAPER 86-042)

The Aeroassist Flight Experiment scheduled for the early 1990's will demonstrate the use of a low L/D lifting brake using aerodynamic drag to return a spacecraft from a high energy to a low earth orbit. The experimental vehicle will be deployed and retrieved by the Shuttle Orbiter. This paper reviews some of the challenges, problems, and solutions encountered to date during guidance system development, with emphasis on technology advances which will benefit an operational Orbit Transfer Vehicle (OTV). Key factors to be discussed include guidance alternatives, aerodynamic modeling, navigation requirements, the impact of atmospheric uncertainties, and flight profile alternatives considered during initial planning.

#### A87-36362

#### THE SERVICE CONCEPT

IAN PARKER Space (ISSN 0267-954X), vol. 3, Mar.-Apr. 1987, p. 33, 35.

The SERVICE (space entry/reentry vehicle in commercial environments) concept is described. The main component of the system is a space recovery vehicle (SRV) which houses a self-contained laboratory or processing facility. The SRV, which can be utilized for the study of genetic engineering, adhesives, composites, and alloys, can be modified to user's requirements and can be flown on various launchers. The dimensions and design of the capsule are discussed. The use of the SRV as an escape capsule for manned space vehicles and for returning cargos from the Space Station to earth is proposed.

A87-37297\*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

## SPACE STATION COMMUNICATIONS AND TRACKING SYSTEM

REINHOLD H. DIETZ (NASA, Johnson Space Center, Houston, TX) IEEE, Proceedings (ISSN 0018-9219), vol. 75, March 1987, p. 371-382.

A comprehensive description of the existing Space Station communications and tracking system requirements, architecture, and design concepts is provided. Areas which will require innovative solutions to provide cost-effective flight systems are emphasized. Among these are the space-to-space links, the differential global positioning system for determining relative position with free-flying vehicles, multitarget radar, packet/isochronous signal processing, and laser docking systems. In addition, the importance of advanced development, tests, and analyses is summarized.

## A87-38755\* Operations Research, Inc., Silver Spring, Md. SERVICING OF USER PAYLOAD EQUIPMENT IN THE SPACE STATION PRESSURIZED ENVIRONMENT

JOEL LEVY, RUTH WHITMAN (ORI, Inc., Silver Spring, MD), THOMAS A. LAVIGNA, and JOHN E. OBERRIGHT (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 571-578.

(SAE PAPER 860973)

NASA Space Station servicing support facilities will include both pressurized and unpressurized work areas. While the latter will allow astronauts operating in EVAs or aided by robots to accomplish Orbital Replacement Unit (ORU) and instrument changes, tests, assembly, refueling, and repairs, the former will furnish astronauts engaged in work requiring intravehicular activities (IVAs) the ability to enter through an airlock into a module in which they can more carefully service ORUs. Baseline IVA accommodations encompass (1) a staging/assembly area for ORUs brought in from satellites, orbital platforms or attached payloads, (2) a work station for monitoring and control of the external Servicing Bay facility, and (3) a large, laminar flow workbench which would provide highly controlled conditions, as well as (4) a 'glovebox' for delicate servicing and (5) an assortment of hand tools and test equipment.

#### A87-38767

#### SPACE STATION EVA SYSTEMS TRADE-OFF MODEL

MAURICE A. CARSON (Eagle Engineering, Inc., Houston, TX), LARRY PRICE (McDonnell Douglas Astronautics Co., Saint Louis, MO), and BRUCE JAGOW (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 691-709.

(SAE PAPER 860990)

A procedure has been developed to predict program costs for conducting extravehicular activity from Space Station. Space Transportation System EMU historical data has been used as a basis for performing the development and production phases. Complexity and risk factors are used to compare costs for various configuration options. Operations costs utilize ground, launch, and on-orbit penalty factors derived from operations analysis and EVA hardware configuration and performance data. Scar costs are based upon weight and flight or ground personnel overhead factors. The model compares nine separate configurations and extends from FY 1987 through the first ten years of Space Station operations. A spreadsheet format together with a grouping of the program constraints promotes rapid recalculations when new input data is desired.

## A87-38769\* Grumman Aerospace Corp., Bethpage, N.Y. ADVANCED ORBITAL SERVICING CAPABILITIES DEVELOPMENT

ROY E. OLSEN (Grumman Corp., Bethpage, NY) and ALBERTA QUINN (NASA, Marshall Space Flight Center, Huntsville, AL) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 719-732.

(Contract NAS8-36427)

(SAE PAPER 860992)

The potential servicing requirements of the Space Station and associated free-flying platforms are identified and analyzed; the selected servicing tasks encompass orbital maneuver vehicle refueling, reaction-control subsystem thruster module replacement, and body-mounted radiator changeout. Attention is presently given to the commonality of all servicing activities, the definition of servicing interfaces, and the roles played by automation and robotics. The servicing concepts for each representative servicing task were selected on the basis of a weighed combination of seven factors: safety, productivity, relative cost, mission effectiveness, design flexibility and simplicity, and development status.

#### A87-38780

### AN EVALUATION OF OPTIONS TO SATISFY SPACE STATION EVA REQUIREMENTS

JOSEPH J. THOMPSON, KENNETH S. BROSSEL (Boeing Aerospace Co., Seattle, WA), and BRUCE W. WEBBON (SRI International, Menlo Park, CA) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 845-861.

(SAE PAPER 861008)

The Space Station mission requirements for initial frequent use of EVA require the modification of the existing Shuttle suit and the Shuttle Extravehicular Mobility Unit (EMU). Options for a Space Station EVA space suit are described and evaluated in light of the Space Station mission human and environmental requirements. The evaluation is made to select the most cost-effective and technologically feasible alternative that meets the requirements. Requirements considered include: (1) the heavy, almost industrial use, of the suit; (2) long operational life; (3) on-orbit maintenance and fit check; (4) high mobility; (5) rapid don/doff; (6) high pressure for zero pre-breath; (7) radiation protection; (8) micrometeroid/space debris protection; (9) thermal insulation; (10) contamination/decontamination factors; (11) automatic checkout; and (12) low development and recurring costs.

#### A87-38781

### AN EVALUATION OF ADVANCED EXTRAVEHICULAR CREW ENCLOSURES

RONALD E. RENMAN and RONALD A. BO (Grumman Aerospace Corp., Bethpage, NY) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 863-871.

(SAE PAPER 861009)

The advanced EVA suits under development by NASA for tasks

requiring high levels of mobility and manual dexterity operate at pressures approaching that of the Space Station interior, thereby obviating the oxygen prebreathing otherwise needed to prevent decompression sickness. Attention is given to the prospects for further enhancement of EVA capabilities through the use of hard, shirtsleeve-condition crew enclosures that employ anthropomorphic arms and dextrous manipulators. The enclosure offering best overall performance and lowest total program costs is a high-pressure suit incorporating a fully regenerable life support system, whose high performance rating depends on the assumed future development of gloves furnishing levels of dexterity comparable to those of existing low pressure designs.

#### A87-38782

### SPACE STATION EVA USING A MANEUVERING ENCLOSURE UNIT

D. PAUL MEYER, JOE J. THOMPSON, and RICHARD L. OLSON (Boeing Aerospace Co., Seattle, WA) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 873-882. refs

(SAE PAPER 861010)

An evaluation is made of an EVA enclosure concept that combines features of the Extravehicular Mobility Unit (EMU) and the Manned Maneuvering Unit, and incorporates robotic elements. This Maneuvering Enclosure Unit (MEU) encompasses docking ring and latching mechanisms, an attachment structure for the grappler and manipulator arms, and packaging facilities for life support and data systems. Prospected performance comparisons are made between the MEU and EMU with respect to versatility, consumables usage, operator acceptance, operations, and design/development factors.

#### A87-40376

#### **ON-ORBIT ASSEMBLY AND REPAIR**

A. JUSTAFERRO, S. C. DEBROCK, H. T. FISHER, G. J. GOULD, S. J. HOUSTON (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) et al. IN: EASCON '86; Proceedings of the Nineteenth Annual Electronics and Aerospace Systems Conference, Washington, DC, Sept. 8-10, 1986. New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 221-243.

The concept of on-oribt assembly and repair is introduced including users, tasks, Space Station and NSTS Interfaces. Representative missions and spacecraft requiring assembly and repair are briefly described along with the specific service requested. Considerations for setting the level of on-orbit replaceable unit (ORU) indenture or packaging size are discussed along with the feasibility of intravehicular activity (IVA) repair at the component and board level. A discussion of broad design guidelines is presented with reference data in easy-acess, tabular form and finally a listing of more than 15 years of servicing design lessons learned are presented.

#### A87-40377

### PLANNING FOR SPACE ROBOTICS DEVELOPMENTS AND APPLICATIONS

DAVID R. CRISWELL (California, University, La Jolla) IN: EASCON '86; Proceedings of the Nineteenth Annual Electronics and Aerospace Systems Conference, Washington, DC, Sept. 8-10, 1986. New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 244-250. refs

Recommendations of the Consortium for Space Automation and Robotics concerning ways to improve the effectiveness of humans in space are examined. Consideration is given to design capture of the Space Station, and the use of smart robots on the Space Station. The applications of space automation and robotics to the initial operating configuration; the operation, maintenance, and housekeeping of the Space Station; and the servicing of satellites are discussed.

### A87-41161\*# Rockwell International Corp., Canoga Park, Calif. CONCEPTS FOR SPACE MAINTENANCE OF OTV ENGINES

A. MARTINEZ, B. D. HINES, and C. M. ERICKSON (Rockwell International Corp., Rocketdyne Div., Canoga Park, CA) Joint Army-Navy-NASA-Air Force Interagency Propulsion Committee, Propulsion Meeting, New Orleans, LA, Aug. 25-28, 1986, Paper. 13 p.

(Contract NAS3-23773)

Concepts for space maintainability of OTV engines are examined. The advanced efforts are based on work recently completed for NASA Lewis Research Center Space Propulsion Technology Division. An engine design is developed which is driven by space maintenance requirements and by a failure modes and effects analysis. Modularity within the engine is shown to offer cost benefits and improved space maintenance capabilities. Space-operable disconnects are conceptualized for both engine change-out and for module replacement. Through FME mitigation the modules are conceptualized to contain the most often replaced engine components. A preliminary space maintenance plan is developed around a controls and condition monitoring system using advanced sensors, controls, and conditioning monitoring concepts.

#### A87-41573

### THE SINGLE-STAGE REUSABLE BALLISTIC LAUNCHER CONCEPT FOR ECONOMIC CARGO TRANSPORTATION

D. E. KOELLE and W. KLEINAU (MBB-ERNO Raumfahrttechnik GmbH, Ottobrunn, West Germany) (IAF, International Astronautical Congress on Space: New Opportunities for all People, 37th, Innsbruck, Austria, Oct. 4-11, 1986) Acta Astronautica (ISSN 0094-5765), vol. 16, 1987, p. 125-130.

A design configuration, performance capability and economic feasibility evaluation is presented for an unmanned, ballistic single-stage-to-orbit (SSTO) booster concept designated 'BETA II'. This SSTO, which would both take off and land vertically, is to be propelled by 13 LOX/LH2-fuel advanced topping cycle engines arranged around a heat shield. BETA II would be capable of lofting 15 metric tons to 200-km orbit, or 12 metric tons to the 500-km, 28.5-deg Space Station orbit. The primary advantage of the BETA II vehicle, which is projected for post-year 2000 service, is its extreme simplicity.

## A87-43060\*# Sydney Univ. (Australia). NONEQUILIBRIUM RADIATION DURING RE-ENTRY AT 10 KM/S

G. A. BIRD (Sydney, University, Australia) AIAA, Thermophysics Conference, 22nd, Honolulu, HI, June 8-10, 1987. 12 p. refs (Contract NAGW-728)

(AIAA PAPER 87-1543)

The direct simulation Monte Carlo method, including a real air model with thermal radiation, is applied to the flows associated with the two sets of measurements that are directly relevant to the projected aeroassisted orbital transfer vehicle. The first is a shock tube measurement of the radiation from a 10 km/s shock wave in air that was made at AVCO in 1962. The second is the flight data that was obtained from the Project Fire re-entry test vehicles in 1964. The calculations for both cases were made with a program that models the one-dimensional flow along a stagnation streamline. The shock standoff distance for the Fire vehicle was obtained from the theoretical studies that were associated with its launch. The simulation employed a partly phenomenological model for the nonequilibrium radiation. It was found that the results from the calculation were consistent with the measured radiation in each case, and also with the convective heat transfer data for the Fire vehicle. The uncertainties associated with the spectral absorptance and recombination probability at the surface appear to be as serious as those associated with the reaction rates.

Author

#### A87-45192#

OPERATION OF THE ORBITAL SPACECRAFT CONSUMABLES RESUPPLY SYSTEM (OSCRS) AT THE SPACE STATION

BARNEY F. GORIN (Fairchild Space Co., Germantown, MD) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 23rd, San

Diego, CA, June 29-July 2, 1987. 9 p. refs (AIAA PAPER 87-1768)

The operation of the OSCRS system is examined with reference to the program background, performance requirements, specific design features of the system, and OSCRS/Space Station interfaces. The system will consist of a family of tankers capable of operation in the Orbiter payload bay, at the Space Station, or remotely when transported by the Orbital Maneuvering Vehicle or the Orbit Transfer Vehicle. They will be transported to orbit either in the Orbiter or on the Expendable Launch Vehicle. When depleted of propellant, they will be returned to earth in the Orbiter for refurbishment and reuse.

#### A87-45525

#### GPS APPLICATIONS TO THE SPACE STATION

U. CHENG, J. HOLMES, G. HUTH, R. SCHOLTZ, and K. T. WOO IN: GLOBECOM '86 - Global Telecommunications Conference, Houston, TX, Dec. 1-4, 1986, Conference Record. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1986, p. 847-851. refs

This paper describes the Space Station's traffic-tracking requirements and reviews arguments which support the conclusion that measurements of Global Positioning System signals can be used to satisfy these requirements. Differential measurement techniques are shown to potentially provide a feasible method for achieving 1 meter location accuracy in proximity operations

#### A87-46000\*# Rockwell International Corp., Canoga Park, Calif. CONCEPTS FOR SPACE MAINTENANCE OF OTV ENGINES

A. MARTINEZ, B. D. HINES, and C. M. ERICKSON (Rockwell International Corp., Rocketdyne Div., Canoga Park CA) Army-Navy-NASA-Air Force Interagency Propulsion Committee, Propulsion Meeting, New Orleans, LA, Aug. 1986, Paper. 13 p. (Contract NAS3-23773)

In this paper, concepts for space maintainability of Orbital Transfer Vehicles engines are examined. An engine design is developed which is driven by space maintenance requirements and by a Failure Modes and Effects Analysis (FMEA). Modularity within the engine is shown to offer cost benefits and improved space maintenance capabilities. Space-operable disconnects are conceptualized for both engine change-out and for module replacement. Through FME mitigation the modules are conceptualized to contain the most often replaced engine components. A preliminary space maintenance plan is developed around a Controls and Condition Monitoring system using advanced sensors, controls, and conditioning monitoring concepts.

#### A87-49618\*# Georgia Inst. of Tech., Atlanta. OPTIMAL HEADING CHANGE WITH MINIMUM ENERGY LOSS FOR A HYPERSONIC GLIDING VEHICLE

ANTHONY J. CALISE and GYOUNG H. BAE (Georgia Institute of Technology, Atlanta) IN: AIAA Atmospheric Flight Mechanics Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers . New York, American Institute of Aeronautics and Astronautics, 1987, p. 417-421. refs (Contract NAG1-660)

(AIAA PAPER 87-2568)

A three state model is presented for analyzing the problem of optimal changes in heading with minimum energy loss for a hypersonic gliding vehicle. A further model order reduction to a single state model is examined using singular perturbation theory. The optimal solution for the reduced problem defines an optimal altitude profile dependent on the current energy of the vehicle, and the corresponding optimal lift and bank angle. A separate boundary layer analysis, based on an expansion of the necessary conditions about the reduced solution, is used to account for altitude and flight path angle dynamics and to derive a guidance law in feedback form. The guidance law is evaluated for a hypothetical Author vehicle.

National Aeronautics and Space Administration. N87-20306\*# Goddard Space Flight Center, Greenbelt, Md. Space Welding Project.

GAS TUNGSTEN ARC WELDING IN A MICROGRAVITY **ENVIRONMENT: WORK DONE ON GAS PAYLOAD G-169** 

BLAKE A. WELCHER, FAYSAL A. KOLKAILAH, and ARTHUR H. MUIR, JR. (Rockwell International Corp., Thousand Oaks, Calif.) In NASA. Goddard Space Flight Center The 1986 Get Away Special Experimenter's Symposium p 23-29 Feb. 1987

Avail: NTIS HC A11/MF A01 CSCL 11F

GAS payload G-169 is discussed. G-169 contains a computer-controlled Gas Tungsten Arc Welder. The equipment design, problem analysis, and problem solutions are presented. Analysis of data gathered from other microgravity arc welding and terrestrial Gas Tungsten Arc Welding (GTAW) experiments are discussed in relation to the predicted results for the GTAW to be performed in microgravity with payload G-169. Author

Science Applications International Corp., N87-20335\*# Schaumberg, III. Space Science Dept.

#### SATELLITE SERVICING MISSION PRELIMINARY COST **ESTIMATION MODEL**

Jan. 1987 38 p (Contract NAS9-17207)

(NASA-CR-171978; NAS 1.26:171978; SAIC-87/1514;

SAIC-1-120-778-C14) Avail: NTIS HC A03/MF A01 CSCL 22A

The cost model presented is a preliminary methodology for determining a rough order-of-magnitude cost for implementing a satellite servicing mission. Mission implementation, in this context, encompassess all activities associated with mission design and planning, including both flight and ground crew training and systems integration (payload processing) of servicing hardward with the Shuttle. A basic assumption made in developing this cost model is that a generic set of servicing hardware was developed and flight tested, is inventoried, and is maintained by NASA. This implies that all hardware physical and functional interfaces are well known and therefore recurring CITE testing is not required. The development of the cost model algorithms and examples of their use are discussed.

#### N87-20628# European Space Agency, Paris (France). SERVICING OF THE POLAR PLATFORM

G. VALENTINY In its Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-sensing (ESPOIR) p 43-47 Nov. 1986 Avail: NTIS HC A07/MF A01

The use of the ESA shuttle Hermes to service the Columbus space station polar platform is discussed. In-orbit servicing is required to achieve the 20 yr specified lifetime for the platform. Hermes can carry 4 people and a 2 ton payload. A typical servicing scenario is presented.

European Space Agency. European Space N87-20641# Technology Center, ESTEC, Noordwijk Research and (Netherlands).

#### PANEL REPORT ON THE POLAR PLATFORM SERVICING APPROACH AND ITS IMPLICATIONS

B. PFEIFFER In its Proceedings of the European Symposium on Opportunities and Instrumentation platform Remote-sensing (ESPOIR) p 107-108 Nov. 1986 Avail: NTIS HC A07/MF A01

Preventive maintenance for polar-platform subsystems and instruments; corrective maintenance for polar-platform subsystems and instruments in the event of failure(s); enhancement of polar-platform capabilities beyond the initial orbit configuration; long-duration missions involving high-repetitivity of Earth observation data; and performing such missions on a cost-effective basis were discussed. A servicing approach and implications and user requirements were reviewed.

N87-22551# General Accounting Office, Washington, D. C. SPACE OPERATIONS: NASA'S USE OF INFORMATION TECHNOLOGY. REPORT TO THE CHAIRMAN, COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY

Apr. 1987 67 p

(GAO/IMTEC-87-20; B-226577) Avail: NTIS HC A04/MF A01 An overview of the information technology that is critical to the missions of NASA are provided. Planning, development, and use of information for three areas (Space Transportation System, space stations, and unmanned space exploration) are discussed.

N87-23682# Air Force Inst. of Tech., Wright-Patterson AFB. Ohio. School of Engineering.

A MULTIPLE ATTRIBUTE DECISION ANALYSIS OF MANNED AIRLOCK SYSTEMS M.S. Thesis

DENNIS P. JEANES Dec. 1986 128 p

(AD-A179241; AFIT/GSO/ENS/86D-3) Avail: NTIS HC A07/MF A01 CSCL 22B

This study is a multiple attribute decision analysis involving five manned airlock alternatives. The five alternatives are the present shuttle airlock system augmented with additional consumable gas tanks, four variations of the Crewlock, a new airlock design concept proposed by Mr. William Haynes of the Aerospace Corporation. The purpose was to identify which airlock system can best support both the normal shuttle mission extravehicular activity (EVA) and the shuttle's EVA requirements during construction of the space station. Only physical characteristics and performance parameters are included in the analysis. Cost factors are not addressed. The analytic hierarchy process (AHP) was used to structure the problem and helped identify and rate ten airlock attributes, safety, reliability, weight, size, volume, transit time, depressurization time, repressurization time, expendable gas usage, and number of EVA periods per mission. Compromise programming was used to identify the airlock system closest to the ideal solution using the AHP-derived weights.

N87-25339\*# National Aeronautics and Space Administration.

#### Lyndon B. Johnson Space Center, Houston, Tex. TRACK AND CAPTURE OF THE ORBITER WITH THE SPACE STATION REMOTE MANIPULATOR SYSTEM

E. M. BAINS (Lockheed Engineering and Management Services Co., Inc., Houston, Tex.), C. R. PRICE, and L. M. WALTER May

(Contract NAS9-17900; NAS9-15800)

(NASA-TM-89221; NAS 1.15:89221) Avail: NTIS HC A02/MF A01 CSCL 22A

Results of the first study using the real-time, man-in-the-loop Systems Engineering Simulator (SES) for track and capture of the Space Shuttle Orbiter with the space station manipulator are presented. The objectives include evaluation of the operational coordination required between the orbiter pilot and the space station manipulator operator, evaluation of the locations and required number of closed-circuit television cameras, and evaluation of the orbiter grapple fixture clearance geometry. The SES is a premium quality real-time facility with full fidelity orbiter and space station crew workstations and cockpits.

N87-25443\*# Texas A&M Univ., College Station. **ELECTROCHEMICAL PROCESSING OF SOLID WASTE** Semiannual Report, Jul. 1987

JOHN OM. BOCKRIS Jul. 1987 48 p

(Contract NAG9-192)

(NASA-CR-181128; NAS 1.26:181128) Avail: NTIS HC A03/MF A01 CSCL 07D

An investigation of electrochemical waste treatment methods suitable for closed, or partially closed, life support systems for manned space exploration is discussed. The technique being investigated involves the electrolysis of solid waste where the aim is to upgrade waste material (mainly fecal waste) to generate gases that can be recycled in a space station or planetary space environment.

N87-26097\*# Rockwell International Corp., Canoga Park, Calif. Rocketdyne Div.

#### CONCEPTS FOR SPACE MAINTENANCE OF OTV ENGINES Interim Report

A. MARTINEZ, B. D. HINES, and C. M. ERICKSON In Johns Hopkins Univ., The 1986 JANNAF Propulsion Meeting, Volume 1 Aug. 1986 (Contract NAS3-23773)

Avail: NTIS HC A25/MF A01 CSCL 21H

Concepts for space maintainability of the Orbital Transfer Vehicle (OTV) engines are examined. An engine design is developed which is driven by space maintenance requirements and by a failure modes and effects analysis (FMEA). Modularity within the engine is shown to offer cost benefits and improved space maintenance capabilities. Space-operable disconnects are conceptualized for both engine change-out and for module replacement. A preliminary space maintenance plan is developed around a controls and condition monitoring system using advanced sensors, controls, and condition monitoring concepts.

N87-26181\*# Vanderbilt Univ., Nashville, Tenn. Dept. of Physics and Astronomy.

#### THE ROLE OF ELECTRONIC MECHANISMS IN SURFACE **EROSION AND GLOW PHENOMENA**

RICHARD F. HAGLUND, JR. In Jet Propulsion Lab., Proceedings of the NASA Workshop on Atomic Oxygen Effects p 63-74 Sponsored in part by Air Force; Navy; Los Alamos National Lab., N. Mex., Sandia National Lab., Albuquerque, N. Mex.; and Martin-Marietta Corp.

Avail: NTIS HC A09/MF A01 CSCL 07D

Experimental studies of desorption induced by electronic transitions (DIET) are described. Such studies are producing an increasingly complete picture of the dynamical pathways through which incident electronic energy is absorbed and rechanneled to produce macroscopic erosion and glow. These mechanistic studies can determine rate constants for erosion and glow processes in model materials and provide valuable guidance in materials selection and development. Extensive experiments with electron, photon, and heavy particle irradiation of alkali halides and other simple model materials have produced evidence showing that: (1) surface erosion, consisting primarily in the ejection or desorption of ground-state neutral atoms, occurs with large efficiencies for all irradiated species; (2) surface glow, resulting from the radiative decay of desorbed atoms, likewise occurs for all irradiating species; (3) the typical mechanism for ground-state neutral desorption is exciton formation, followed by relaxation to a permanent, mobile electronic defect which is the precursor to bond-breaking in the surface or near-surface bulk of the material; and (4) the mechanisms for excited atom formation may include curve crossing in atomic collisions, interactions with surface defect or impurity states, or defect diffusion.

N87-26927\*# Georgia Inst. of Tech., Atlanta, School of Aerospace Engineering.

SINGULAR PERTURBATION ANALYSIS OF ACTV RELATED TRAJECTORY OPTIMIZATION PROBLEMS Progress Report, 14 Apr. - 30 Oct. 1986

ANTHONY J. CALISE Nov. 1986 16 p

(Contract NAG1-660)

(NASA-CR-180301; NAS 1.26:180301) Avail: NTIS HC A02/MF

The problem of aeroassisted orbital plane change is discussed. This maneuver requires the use of three impulses - one to deorbit, one to reorbit and one to recircularize at the new orbit. The orbit plane change is effected entirely in the atmosphere through the use of lift and bank angle control. For circular orbits of nearly equal radii, it can be shown that the fuel consumption is minimized by minimizing the energy loss in the atmospheric portion of the trajectory. The research explores the use of singular perturbation theory to develop an optimal guidance law for the atmospheric portion.

N87-28577 Michigan Univ., Ann Arbor.
OPTIMAL NODAL TRANSFER AND AEROASSISTED
TRANSFER BY AEROCRUISE Ph.D. Thesis

SHAU-HERN KUO 1987 165 p Avail: Univ. Microfilms Order No. DA8712155

In view of the increasing human activity in space, the maneuvering between different orbits is going to be a regular and also an important part of space transportation. Some contributions are provided to the problem of minimum fuel, time-free transfer between non-coplanar elliptical orbits both in the pure propulsive mode and the aeroassisted mode. The reference gain introduced gives a good initial guess and can solve all the two impulse time-free orbital transfer problems, and have a better evaluation between the propulsive transfer and the aeroassisted orbital transfer. From the discovery of the closeness between the minimum nodal transfer and the true optimum transfer, the former can be used as a good approximation and checkout the latter. Also the general view about the permissible thrust angles and the impulse position restriction can give a guide in designing a near optimal orbit transfer. The optimal control problem in aerocruise at constant altitude reveals that the optimal control strategy is better than the result from parameter optimization, not only for the plane change ability but also in reducing the acceleration load.

N87-28588# Selenia S.p.A., Rome (Italy).
RENDEZVOUS AND DOCKING (RVD) LONG RANGE RF
SENSOR DEFINITION STUDY, EXECUTIVE SUMMARY

Paris, France ESA 1986 114 p (Contract ESA-6093/84-NL-GM(SC))

(SES/ENG/ES-519/86; ESA-CR(P)-2367; ETN-87-90471) Avail:

NTIS HC A06/MF A01

A 90 GHz radar, an S-band lobe switching sensor, and S-band phase switching sensors were compared for use as rendezvous and docking long range sensor aboard the chaser satellite. The lobe switching concept best meets requirements of target satellite acquisition (at a range of the order of 100 km) and operation at a range less than 100 m; measurement of relative distance (between chaser and target) with accuracy of 1 m (at short range); measurement of relative velocity (between chaser and target) with accuracy of 1 cm/sec (at short range); measurement of relative position (between chaser and target) expressed as bearing angles with respect to reference frame in the chaser, with accuracy of 0.5 deg in the field of view of +/- 30 deg; and measurement of bearing angle rates with respect to the reference frame in the chaser with accuracy of 0.05 deg/sec.

N87-29168\*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

KSC SPACE STATION OPERATIONS LANGUAGE (SSOL)

In NASA, Washington, Proceedings: Computer Science and Data
Systems Technical Symposium, Volume 2 22 p Aug. 1985

Avail: NTIS HC A17/MF A01 CSCL 09B

The Space Station Operations Language (SSOL) will serve a large community of diverse users dealing with the integration and checkout of Space Station modules. Kennedy Space Center's plan to achieve Level A specification of the SSOL system, encompassing both its language and its automated support environment, is presented in the format of a briefing. The SSOL concept is a collection of fundamental elements that span languages, operating systems, software development, software tools and several user classes. The approach outlines a thorough process that combines the benefits of rapid prototyping with a coordinated requirements gathering effort, yielding a Level A specification of the SSOL requirements.

N87-29877\*# Rockwell International Corp., Downey, Calif. Space Station Systems Div.

SPACE STATION BASED OPTIONS FOR ORBITER DOCKING/BERTHING

DANIEL J. HOOVER In NASA-Lyndon B. Johnson Space Center, The 21st Aerospace Mechanisms Symposium p 261-273 May 1987

Avail: NTIS HC A16/MF A01 CSCL 22B

Conceptual efforts to develop a Space Station based system for docking and/or berthing the NSTS Orbiter are described. Past docking and berthing systems are reviewed, the general requirements and options for mating the Orbiter and Space Station are discussed, and the rationale for locating the system on the Station is established. One class of Station-based system is developed in several variations and evaluated with respect to weight distribution, loads, safety, reliability, viewing, and maintainability. An evolutionary presentation of the variations provides insight into the development process and the problems encountered. An overall evaluation of the Station-based variations compared to an optimized Orbiter-based system demonstrates the potential benefits of this approach as well as the issues that must be resolved to realize the benefits.

N87-29878\*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

# AN ELECTROMECHANICAL ATTENUATOR/ACTUATOR FOR SPACE STATION DOCKING

LEBARIAN STOKES, DEAN GLENN, and MONTY B. CARROLL (Lockheed Engineering and Management Services Co., Inc., Houston, Tex.) *In its* The 21st Aerospace Mechanisms Symposium p 275-284 May 1987

Avail: NTIS HC A16/MF A01 CSCL 22B

The development of a docking system for aerospace vehicles has identified the need for reusable and variably controlled attenuators/actuators for energy absorption and compliance. One approach to providing both the attenuator and the actuator functions is by way of an electromechanical attenuator/actuator (EMAA) as opposed to a hydraulic system. The use of the electromechanical devices is considered to be more suitable for a space environment because of the absence of contamination from hydraulic fluid leaks and because of the cost effectiveness of maintenance. A smart EMAA that uses range/rate/attitude sensor information to preadjust a docking interface to eliminate misalignments and to minimize contact and stroking forces is described. A prototype EMAA was fabricated and is being tested and evaluated. Results of preliminary testing and analysis already performed have established confidence that this concept is feasible and will provide the desired reliability and low maintenance for repetitive long term operation typical of Space **Author** requirements.

17

#### **SPACE ENVIRONMENT**

Includes description of the space environment and effects on Space Station subsystems. Includes requirements for Space Station to accommodate this environment.

A87-34460\*# National Aeronautics and Space Administration.

Marshall Space Flight Center, Huntsville, Ala.

POTENTIAL MODULATION ON THE SCATHA SPACECRAFT P. D. CRAVEN (NASA, Marshall Space Flight Center, Huntsville, AL), R. C. OLSEN (Alabama, University, Huntsville), J. FENNELL, D. CROLEY (Aerospace Corp., Los Angeles, CA), and T. AGGSON (NASA, Goddard Space Flight Center, Greenbelt, MD) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 24, Mar.-Apr. 1987, p. 150-157. refs

(Contract F04701-85-C-0086; NAS8-33982)

A small (1-V) modulation of the spacecraft potential is observed on the SCATHA satellite through its effects on the data from four instruments: two particle detectors and two field detectors. It is shown that there is a strong causal link between the modulation of the potential at this 1-V level and a nonuniform distribution of the photoemissive properties of the conducting material on the surface of the satellite.

Author

#### A87-38622

### MARTIN MARIETTA ATOMIC OXYGEN BEAM FACILITY

GARY W. SJOLANDER and LYLE E. BAREISS (Martin Marietta Corp., Denver, CO) IN: International SAMPE Technical Conference, 18th, Seattle, WA, Oct. 7-9, 1986, Proceedings. Covina, CA, Society for the Advancement of Material and Process Engineering, 1986, p. 722-731. refs

An atomic oxygen (AO) beam facility for the investigation of atomic oxygen interaction on space related material surfaces is described. The 5-eV beam energy and 10 to the 14th - 10 to the 15th/sq cm per sec atomic oxygen flux simulate the low earth orbit oxygen environment. The AO apparatus combined with a solar simulator and a controllable residual background allows the investigation of various synergistic effects that play a role in Shuttle bay chemistry. The combined goals for this facility include developing a fundamental understanding of AO surface interactions and the screening of space materials for long duration missions.

Author

# A87-38623\* Physical Sciences, Inc., Andover, Mass. A HIGH FLUX PULSED SOURCE OF ENERGETIC ATOMIC OXYGEN

ROBERT H. KRECH and GEORGE E. CALEDONIA (Physical Sciences, Inc., Andover, MA) IN: International SAMPE Technical Conference, 18th, Seattle, WA, Oct. 7-9, 1986, Proceedings . Covina, CA, Society for the Advancement of Material and Process Engineering, 1986, p. 752-760. refs (Contract NAS7-936)

The design and demonstration of a pulsed high flux source of nearly monoenergetic atomic oxygen are reported. In the present test setup, molecular oxygen under several atmospheres of pressure is introduced into an evacuated supersonic expansion nozzle through a pulsed molecular beam valve. A 10J CO2 TEA laser is focused to intensities greater than 10 to the 9th W/sq cm in the nozzle throat, generating a laser-induced breakdown with a resulting 20,000-K plasma. Plasma expansion is confined by the nozzle geometry to promote rapid electron-ion recombination. Average O-atom beam velocities from 5-13 km/s at fluxes up to 10 to the 18th atoms/pulse are measured, and a similar surface oxygen enrichment in polyethylene samples to that obtained on the STS-8 mission is found.

### A87-38624

# PRODUCTION OF A BEAM OF GROUND STATE OXYGEN ATOMS OF SELECTABLE ENERGY

RAYMOND D. REMPT (Boeing Aerospace Co., Seattle, WA) IN: International SAMPE Technical Conference, 18th, Seattle, WA, Oct. 7-9, 1986, Proceedings . Covina, CA, Society for the Advancement of Material and Process Engineering, 1986, p. 761-768.

A method for the production of a fast neutral beam of ground state oxygen atoms with selectable energy from 1/2-20 electron volts is described, with application to the examination and qualification of test material types for LEO deployment. O(-) ions are produced by resonance dissociative attachment of N2O, and the negative ions are then electrostatically accelerated to the desired energy and presented to the laser beam (whose wavelength is shorter than the corresponding electron affinity of the oxygen atom). The resultant beam contains only ground state atoms, and the process may be used to produce a fast atomic nitrogen or hydrogen beam. It is predicted that fluxes of 10 to the 15th atoms/sq cm sec are possible with the present method.

**A87-38643\*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

# SPACE ENVIRONMENTAL EFFECTS ON ADHESIVES FOR THE GALILEO SPACECRAFT

F. L. BOUQUET and T. HASEGAWA (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) IN: International SAMPE Technical Conference, 18th, Seattle, WA, Oct. 7-9, 1986, Proceedings . Covina, CA, Society for the Advancement of Material and Process Engineering, 1986, p. 1101-1110. refs

Requirements for the adhesives used on the Galileo Jovian probe are discussed, and the results of mechanical and radiation

experiments for their qualification are presented. The five types of adhesives used for the Wide Field Camera, SXA Antenna, temperature control louvers, and structural bonds all passed the proton and electron tests and the low temperature radiation tests. Possible bond improvements through techniques including gamma ray radiation exposure and ion implantation are also considered.

RR

**A87-38715\*** National Aeronautics and Space Administration, Washington, D.C.

### RADIATION DOSE PREDICTION FOR SPACE STATION

PERCIVAL D. MCCORMACK (NASA, Office of the Space Station, Washington, DC) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 123-140. refs (SAE PAPER 860924)

A detailed examination is conducted of the basis for the significant differences in Space Station radiation dose predictions that result from magnetic field model extrapolations into the future, with attention to the radiation attenuation effects of the residual atmospheric layer at altitudes of less than 1000 km. A model adjustment is proposed to supplant the arbitrary procedure of magnetic field extrapolation into the future. At altitudes below 500 km and low inclination, and with nominal module wall thicknesses, the new predictions for a 90-day Space Station tour are found to be well within current radiation dose limit guidelines.

O.C.

#### A87-44392

# ORBITAL DEBRIS ENVIRONMENT RESULTING FROM FUTURE ACTIVITIES IN SPACE

SHIN-YI SU (National Central University, Chung-Li, Republic of China) (COSPAR and IAF, Plenary Meeting, 26th, Topical Meetings and Workshop on Cosmic Dust and Space Debris, 6th, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 7, 1986, p. 109-117. refs

A long-term evolution of space debris environment has been simulated by a numerical model. Based on previously published results in many 50-year runs of the 'dynamic model', an 'average model' is derived to reduce the computation time in order to effectively simulate a very-long-term evolution of space debris environment. The evolution of space debris environment is examined with two different future space activities in LEO: (1) involving an increase of the yearly traffic input of new satellites by 2, 5, 10, 20, and 50 percent; and (2) placing ten large space structures of 100 meters diameter in the year 1995 at either 500-km or 1000-km altitude. The results indicate that in a 170-year span from 1983, every space activity listed above results in a rapid runaway of debris fluxes from objects of 4 mm or larger. Author

# A87-49026\* California Univ., Berkeley. RADIATION ENVIRONMENTS AND ABSORBED DOSE ESTIMATIONS ON MANNED SPACE MISSIONS

S. B. CURTIS (California, University, Berkeley), W. ATWELL, R. BEEVER (Rockwell International Corp., Houston, TX), and A. HARDY (NASA, Johnson Space Center, Houston, TX) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 269-274. refs

The dose and dose-equivalent estimates that astronauts might be expected to receive in space were assessed for the development of new radiation protection guidelines, considering several space mission scenarios. These scenarios included a 90-day LEO mission at 450 km altitude with orbital inclinations appropriate for NASA's Space Station (28.5, 57, and 90 deg), a 15-day sortie to GEO, and a 90-day lunar mission. All the missions contemplated would present space travelers with dose equivalents between 5 and 10 rem to the blood-forming organs, assuming no encounter with a large solar particle event; a large particle event could add

considerable exposure for all scenarios except for the one at 28.5 orbital inclination. Adequate shielding must be included to guard against the radiation produced by such events.

A87-51713\* Maxwell Labs., Inc., San Diego, Calif.
RAM ION SCATTERING CAUSED BY SPACE SHUTTLE V X B
INDUCED DIFFERENTIAL CHARGING

I. KATZ and V. A. DAVIS (Maxwell Laboratories, Inc., S-Cubed Div., La Jolla, CA) Journal of Geophysical Research (ISSN 0148-0227), vol. 92, Aug. 1, 1987, p. 8787-8791. refs (Contract NAS3-23881)

Observations of secondary, high-inclination ions streams have been reported in the literature. The authors of these previous papers attributed the source of the secondary ions to a disturbed region in the plasma about 10 m from the Space Shuttle Orbiter. A new theory has been developed which shows how v x B induced differential charging on the plasma diagnostics package (PDP) can scatter the ram ion flux. Some of these ions are reflected back to the PDP and may be the sorce of the observed ion distributions. The effect is unique to large spacecraft; it occurs only when the magnitude of the induced v x B potentials are much larger than the electron thermal energy and of the order of the ion ram energy. That the ion streams observed at large angles must have been reflected from the PDP surface is demonstrated three-dimensional sheath and particle trajectory calculations using the low earth orbit version of the NASA Charging Analyzer Program (NASCAP/LEO).

N87-20795\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

DOCUMENTATION OF THE SPACE STATION/AIRCRAFT ACOUSTIC APPARATUS

SHERMAN A. CLEVENSON Feb. 1987 32 p (NASA-TM-89111; NAS 1.15:89111) Avail: NTIS HC A03/MF A01 CSCL 20A

This paper documents the design and construction of the Space Station/Aircraft Acoustic Apparatus (SS/AAA). Its capabilities both as a space station acoustic simulator and as an aircraft acoustic simulator are described. Also indicated are the considerations which ultimately resulted in man-rating the SS/AAA. In addition, the results of noise surveys and reverberation time and absorption coefficient measurements are included.

N87-21024# Aerospace Corp., El Segundo, Calif. Space Sciences Lab.

POTENTIAL MODULATIONS ON SCATHA (SPACECRAFT CHARGING AT HIGH ALTITUDE) SPACECRAFT

P. D. CRAVEN, R. C. OLSEN, T. AGGSON, J. F. FENNELL, and D. R. CROLEY, JR. 30 Sep. 1986 36 p (Contract F04701-85-C-0086)

(AD-A176815; TR-0086(6940-05)-13; SD-TR-86-92) Avail: NTIS HC A03/MF A01 CSCL 04A

A small (1 volt) modulation of the spacecraft potential is observed on the SCATHA satellite through its effects on four instruments, two particle detectors and two field detectors. It is shown that there is a strong causal link between the modulation of the potential at this 1 volt level and a nonuniform distribution of the photoemissive properties of the conducting material on the surface of the satellite.

N87-21991# Severn Communications Corp., Severna Park, Md. RADIATION SHIELDING REQUIREMENTS ON LONG-DURATION SPACE MISSIONS

JOHN R. LETAW and SCOTT CLEARWATER 21 Jul. 1986 40 p Prepared in cooperation with Los Alamos National Lab., N. Mex.

(Contract N00014-85-C-2200)

(AD-A177512; SCC-86-02) Avail: NTIS HC A03/MF A01 CSCL

An analysis of radiation shielding requirements on long duration space missions is presented. The report finds the principal radiation hazards to be galactic cosmic radiation (cosmic rays) and radiation from solar flares. Galactic cosmic radiation is a continuous source of radiation delivering a dose equivalent to the blood-forming organs varying from 20 REM/year to 50 REM/year over the 11 year solar cycle. Solar flares are randomly distributed events which are occasionally associated with lethal particle fluxes. The following recommendations are made: Investigate alternative shielding materials which may be more effective against radiation hazards discussed here; A solar flare storm shelter with a minimum of 7.5 cm aluminum shielding (or shielding of equivalent effect) is required at all times for spaceflights outside the magnetosphere. Spacecraft designed to transport people outside the magnetosphere for long durations during solar minimum must provide at least 7.5 cm aluminum shielding of all living spaces. Acceptable dose limits for the full scale exploration and industrialization of space must be studied.

N87-23066\*# Massachusetts Inst. of Tech., Cambridge. Plasma Fusion Center.

A PRELIMINARY STUDY OF EXTENDED MAGNETIC FIELD STRUCTURES IN THE IONOSPHERE Status Report

JAMES D. SULLIVAN, BARTON G. LANE, and RICHARD S. POST 18 Jun. 1987 21 p (Contract NAG5-874)

(NASA-CR-181004; NAS 1.26:181004) Avail: NTIS HC A02/MF A01 CSCL 04A

Several plasma phenomena which are to be expected around a magnet in LEO were identified and analyzed qualitatively. The ASTROMAG cusp magnet will create an extended field whose strength drops to the ambient level over a scale length of approx. 15 m; the combined field has a complex topology with ring nulls and open and closed field lines. The entire configuration is moving through the partially ionized F-layer of the ionosphere at a speed slow compared to the local Alfven speed but fast compared to the ion sound speed. The ambient plasma crosses the extended field structure in a time short compared to the ion Larmor period vet long relative to the electron Larmor period. Thus, electrons behave as a magnetized fluid while ions move ballistically until reflected from higher fields near the cusp. Since the Debye length is short compared to the field scale length, an electrostatic shock-like structure forms to equilibrate the flows and achieve quasi-neutrality. The ambient plasma will be excluded from a cavity near the magnet. The size and nature of the strong interaction region in which the magnet significantly perturbs the ambient flow were determined by studying ion orbits numerically. Lecture viewgraphs summarizing these results are presented.

N87-23678# TRW Space Technology Labs., Redondo Beach, Calif. System Integration Lab.

SPACECRAFT ENVIRONMENT INTERACTION INVESTIGATION Final Report, Oct. 1983 - Sep. 1986

N. J. STEVENS and MARC E. KIRKPATRICK Oct. 1986 175 p (Contract F19628-84-C-0038)

(AD-A179183; TRW-43543-6011-UE-00; AFGL-TR-86-0214)

Avail: NTIS HC A08/MF A01 CSCL 22B

This report summarizes the results of the spacecraft environment interaction investigation. The objectives of this investigation were to characterize environmental interaction technology and to determine the adequacy of present military standards and handbooks for future, large AF missions. The characterization of the technology status was accomplished by literature searches and key-expert questionnaires. The determination of military standard adequacy was accomplished by considering interactions with five concepts synthesized from those available in the MSSTP. Based on these concepts studies, critical interactions were identified. The available military documentation was searched for applicability. A recommended document development plan was prepared along with a discussion of technology gaps.

N87-24515 Colorado Univ., Boulder.

SIMULATION OF ON-ORBIT SATELLITE FRAGMENTATIONS Ph.D. Thesis

DARREN SCOTT MCKNIGHT 1986 241 p Avail: Univ. Microfilms Order No. DA8706439

The debris from nearly ninety satellites that have fragmented pose a serious hazard to all space systems in Earth orbit. A program has been developed which simulates fragmentation events whose magnitude, size distribution, velocity distribution, geometry, and location of breakup may all be controlled. This numerical model simulates in-orbit satellite fragmentations generating debris fragments across the entire size spectrum, many of which would be nondetectable by the NORAD Space Network. Monte Carlo methods are used to generate the size and velocity distributions of fragments according to hypothetical distributions derived from laboratory experiments. After breakup, the particles' orbits are propagated under the influence of drag and the J sub 2 gravitational term. This simulation program provides insight into the nontrackable debris population available through no other means. The simulation of the Kosmos 1275 breakup supports the speculation that it is the first accidental collision-induced satellite breakup.

Dissert. Abstr.

N87-26082\*# Alabama Univ., Huntsville. Dept. of Mechanical Engineering.

#### CONTAMINATION ASSESSMENT FOR OSSA SPACE STATION IOC PAYLOADS Final Report, 25 Jul. 1986 - 25 Jul. 1987

S. T. WU Aug. 1987 137 p (Contract NAG8-592)

(NASA-CR-181165; NAS 1.26:181165) Avail: NTIS HC A07/MF A01 CSCL 22B

An assessment is made of NASA/OSSA space station IOC payloads. The report has two main objectives, i.e., to provide realistic contamination requirements for space station attached payloads, serviced payloads and platforms, and to determine unknowns or major impacts requiring further assessment. Author

N87-26173\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

#### PROCEEDINGS OF THE NASA WORKSHOP ON ATOMIC **OXYGEN EFFECTS**

DAVID E. BRINZA, ed. 1 Jun. 1987 195 p Workshop held in Pasadena, Calif., 10-11 Nov. 1986 (Contract NAS7-918)

(NASA-CR-181163; JPL-PUB-87-14; NAS 1.26:181163) Avail: NTIS HC A09/MF A01 CSCL 07D

A workshop was held to address the scientific issues concerning the effects of atomic oxygen on materials in the low Earth orbital (LEO) environment. The program included 18 invited speakers plus contributed posters covering topics such as LEO spaceflight experiments, interaction mechanisms, and atomic oxygen source development. Discussion sessions were also held to organize a test program to evaluate atomic oxygen exposure facilities. The key issues raised in the workshop were: (1) the need to develop a reliable predictive model of the effects of long-term exposure of materials to the LEO environment; (2) the ability of ground-based exposure facilities to provide useful data for development of durable materials; and (3) accurate determination of the composition of the LEO environment. These proceedings include the invited papers, the abstracts for the contributed posters, and an account of the test program discussion sessions.

N87-26176\*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

## MASS SPECTROMETERS AND ATOMIC OXYGEN

D. E. HUNTON, E. TRZCINSKI, J. B. CROSS, L. H. SPANGLER, M. H. HOFFBAUER, F. H. ARCHULETA (Los Alamos National Lab., N. Mex.), and J. T. VISENTINE /n Jet Propulsion Lab., Proceedings of the NASA Workshop on Atomic Oxygen Effects p 21-28 1 Jun. 1987

Avail: NTIS HC A09/MF A01 CSCL 07D

The likely role of atmospheric atomic oxygen in the recession of spacecraft surfaces and in the shuttle glow has revived interest in the accurate measurement of atomic oxygen densities in the upper atmosphere. The Air Force Geophysics Laboratory is supplying a quadrupole mass spectrometer for a materials interactions flight experiment being planned by the Johnson Space Center. The mass spectrometer will measure the flux of oxygen

on test materials and will also identify the products of surface reactions. The instrument will be calibrated at a new facility for producing high energy beams of atomic oxygen at the Los Alamos National Laboratory. The plans for these calibration experiments are summarized.

N87-26178\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

#### **O-ATOM DEGRADATION MECHANISMS OF MATERIALS**

DANIEL R. COULTER, RANTY H. LIANG, SHIRLEY Y. CHUNG, KERI ODA SMITH, and AMITAVA GUPTA In its Proceedings of the NASA Workshop on Atomic Oxygen Effects p 39-46

Avail: NTIS HC A09/MF A01 CSCL 07D

The low Earth orbit environment is described and the critical issues relating to oxygen atom degradation are discussed. Some analytic techniques for studying the problem and preliminary results on the underlying degradation mechanisms are presented.

Author

N87-26179\*# National Bureau of Standards, Gaithersburg, Md. Chemical Kinetics Div.

#### KINETICS AND MECHANISMS OF SOME ATOMIC OXYGEN REACTIONS

R. J. CVETANOVIC In Jet Propulsion Lab., Proceedings of the NASA Workshop on Atomic Oxygen Effects p 47-54 1987

Avail: NTIS HC A09/MF A01 CSCL 07D

Mechanisms and kinetics of some reactions of the ground state of oxygen atoms, O(3P), are briefly summarized. Attention is given to reactions of oxygen atoms with several different types of organic and inorganic compounds such as alkanes, alkenes, alkynes, aromatics, and some oxygen, nitrogen, halogen and sulfur derivatives of these compounds. References to some recent compilations and critical evaluations of reaction rate constants are given. Author

## N87-26183\*# Chicago Univ., III. DYNAMICS OF ATOM-SURFACE INTERACTIONS Abstract

STEVEN J. SIBENER In Jet Propulsion Lab., Proceedings of the NASA Workshop on Atomic Oxygen Effects p 89 Avail: NTIS HC A09/MF A01 CSCL 07D

Scattering techniques currently being used to examine the dynamics and energetics of gas-surface energy exchange processes and gas-surface reaction mechanisms are reviewed. In particular, recent inelastic scattering measurements are highlighted which are revealing the microscopic basis for collision-induced gas-surface energy exchange, e.g., which surface vibrational modes actively participate in translational energy accommodation. Reactive scattering and laser desorptive experiments which examine energy disposal in volatile products are also discussed. Finally, an efficient atomic oxygen beam source is described which is suitable for terrestrial studies of gas-surface interactions.

N87-26186\*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

#### HIGH INTENSITY 5 EV ATOMIC OXYGEN SOURCE AND LOW EARTH ORBIT (LEO) SIMULATION FACILITY

J. B. CROSS, L. H. SPANGLER, M. A. HOFFBAUER, F. A. ARCHULETA (Los Alamos National Lab., N. Mex.), LUBERT LEGER, and JAMES VISENTINE In Jet Propulsion Lab.. Proceedings of the NASA Workshop on Atomic Oxygen Effects p 105-117 ັ 1 Jun. 1987

Avail: NTIS HC A09/MF A01 CSCL 07D

An atomic oxygen exposure facility has been developed for studies of material degradation. The goal of these studies is to provide design criteria and information for the manufacture of long life (20 to 30 years) construction materials for use in LEO. The studies that are being undertaken using the facility will provide: absolute reaction cross sections for use in engineering design problems; formulations of reaction mechanisms; and calibration of flight hardware (mass spectrometers, etc.) in order to directly relate experiments performed in LEO to ground based investigations. The facility consists of: (1) a CW laser sustained discharge source of O atoms having a variable energy up to 5 eV and an intensity between 10(15) and 10(17) O atoms s(-1) cm(-2); (2) an atomic beam formation and diagnostics system consisting of various stages of differential pumping, a mass spectrometer detector, and a time of flight analyzer; (3) a spinning rotor viscometer for absolute O atom flux measurements; and (4) provision for using the system for calibration of actual flight instruments. Surface analysis equipment is available for the characterization of material surfaces before and after exposure to O atoms.

N87-26204\*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

#### MARTIN MARIETTA ATOMIC OXYGEN LOW EARTH ORBIT (LEO) SIMULATION Abstract Only

GARY W. SJOLANDER and LYLE BAREISS In its Proceedings of the NASA Workshop on Atomic Oxygen Effects p 168

Avail: NTIS HC A09/MF A01 CSCL 14B

An atomic oxygen beam apparatus that produces flux levels and atomic kinetic energy similar to that encountered by spacecraft in low Earth orbit (LEO) is described. The beam apparatus consists of an electric discharge ion source, mass filter, decelerator, and neutralizer. Specific design goals include a 1.3 cm beam diameter, a 5 eV beam energy, and a flux density on the order of 10(15) cm(-2) s(-1). The total fluence will be on the order of 10(19) cm(-2) for an 8 hour test. The neutral oxygen beam will expose various materials contained within a large target chamber. Within the chamber will be a rather complex suite of instrumentation that will allow real-time studies of material mass loss and reactant species spatial distribution. In addition, a UV solar simulator will aid in the understanding of various synergistic effects.

N87-26207\*# Communications Research Centre, Ottawa (Ontario).

#### EFFECT OF LONG-TERM EXPOSURE TO LOW EARTH ORBIT (LEO) SPACE ENVIRONMENT

D. G. ZIMCIK In Jet Propulsion Lab., Proceedings of the NASA Workshop on Atomic Oxygen Effects p 171 1 Jun. 1987 Avail: NTIS HC A09/MF A01 CSCL 07D

Data obtained from components and materials from the Solar Maximum Mission satellite are presented and compared to data for similar materials obtained from the Advanced Composite Materials Exposure to Space Experiment (ACOMEX) flown on Shuttle mission STS-41G. In addition to evaluation of surface erosion and mass loss that may be of importance to very long-term missions, comparisons of solar absorptance and thermal emittance measurements for both long and short term exposures were made. Although the ratio of absorptance over emittance can be altered by proper choice of materials to ensure a proper operating environment for the spacecraft, once the thermal design is established, it is important that the material properties not change in order to maintain the operating environment for many payload and bus items such as electronics, batteries, fuel, etc. However, data presented show significant changes after short exposure in low Earth environment. Moreover, the measured changes are shown to differ according to the manner of exposure, i.e., normal or oblique, which also affects the resultant eroded surface morphology. These results identify constraints to be considered in development of flight experiments or laboratory testing.

Advisory Group for Aerospace Research and N87-26937# Development, Neuilly-Sur-Seine (France). Electromagnetic Wave Propagation Panel.

#### THE AEROSPACE ENVIRONMENT AT HIGH ALTITUDES AND ITS IMPLICATIONS FOR SPACECRAFT CHARGING AND COMMUNICATIONS

May 1987 286 p In ENGLISH and FRENCH Symposium held in The Hague, Netherlands, 2-6 Jun. 1986 (AGARD-CP-406; ISBN-92-835-0418-6; AD-A185880) Avail: NTIS HC A13/MF A01 CSCL 22B

The symposium examined how the magnetosphere and polar

plasmas vary as a result of natural causes and man-made perturbations, and the implications of these variations for the charging and differential charging of spacecraft with their effects, in turn, on spacecraft systems and communications. A better understanding of these phenomena can help to design of spacecraft systems and subsystems to minimize the effects of these disturbances.

N87-26942# Royal Aircraft Establishment, Farnborough (England). Radio and Navigation Dept.

#### THE USE OF PI2 PULSATIONS AS INDICATORS OF SUBSTORM EFFECTS AT GEOSTATIONARY ORBIT

In AGARD, The Aerospace Environment at High M. LESTER Altitudes and its Implications for Spacecraft Charging and Communications 9 p May 1987

Avail: NTIS HC A13/MF A01

Some of the characteristics of Pi2 pulsations observed at mid-latitudes on the ground are reviewed and the use of certain characteristics in indicating various magnetic and particle perturbations occurring during substorms are assessed. Spacecraft charging and its effects at geosynchronous orbit also reviewed. There is a brief discussion of how Pi2 pulsations might be used to predict intervals of spacecraft charging at geosynchronous

#### N87-26946\*# Alabama Univ., Huntsville. Dept. of Physics. **ELECTRON BEAM EXPERIMENTS AT HIGH ALTITUDES**

R. C. OLSEN In AGARD, The Aerospace Environment at High Altitudes and its Implications for Spacecraft Charging and Communications 8 p May 1987 (Contract NAG3-620)

Avail: NTIS HC A13/MF A01 CSCL 22B

Experiments with the electron gun on the SCATHA satellite produced evidence of beam-plasma interactions, and heating of the low energy electrons around the satellite. These experiments were conducted near geosynchronous orbit, in the dusk bulge, and plasma sheet, with one short operation in the lobe regions, providing a range of ambient plasma densities. The electron gun was operated at 50 eV, with beam currents of 1, 10, and 100 micro-A. Data from electrostatic analyzers and the DC electric field experiment show that the satellite charged to near the beam energy in sunlight, if the beam current was sufficient. Higher ambient densities required higher beam currents. The electrostatic analyzers showed distribution functions which had peaks, or plateaus, at energies greater than the satellite potential. These measurements indicate heating of the ambient plasma at several Debye lengths from the satellite, with the heated plasma then accelerated into the satellite. It is likely that the ambient plasma is in fact the photoelectron sheath generated by the satellite.

#### N87-26949# York Univ., Toronto (Ontario). Dept. of Physics. SPACECRAFT CHARGING IN THE AURORAL PLASMA: PROGRESS TOWARD UNDERSTANDING THE PHYSICAL **EFFECTS INVOLVED**

J. G. LAFRAMBOISE and L. W. PARKER (Parker, Lee W., Inc., Concord, Mass ) In AGARD, The Aerospace Environment at High Altitudes and its Implications for Spacecraft Charging and Communications 16 p May 1987 (Contract F19628-83-K-0028)

Avail: NTIS HC A13/MF A01

The main differences between the plasma environments in geostationary orbit and low polar orbit with respect to high-voltage charging situations are reviewed. Results are presented from a calculation of secondary electron escape currents from negatively charged spacecraft surfaces having various orientations relative to the local magnetic field direction. A simple rough estimate of the required conditions for high-voltage auroral-zone charging is developed. The results suggest that for any given spacecraft, surface potentials are likely to depend more strongly on the ratio of ambient flux of high-energy electrons to that of all ions, than any other environmental parameter. Preliminary results of simulation work directed toward testing this hypothesis are presented.

Author

N87-26952# Toronto Univ. (Ontario). Dept. of Electrical Engineering.

## ARC PROPAGATION, EMISSION AND DAMAGE ON SPACECRAFT DIELECTRICS

K. G. BALMAIN *In* AGARD, The Aerospace Environment at High Altitudes and its Implications for Spacecraft Charging and Communications 7 p May 1987

Avail: NTIS HC A13/MF A01

A review is given of the literature on the subject of arc discharges on spacecraft dielectric materials which have become charged by energetic electrons and ions. Arcs resulting from the charging of spacecraft dielectrics can be very strong because the charge over a large area is mobilized through the phenomenon of arc propagation. The resultant damage patterns on the dielectric are shown to be related to arc patterns, and to the optical anisotropy and crystallinity of the material. The evidence for dielectric melting is suggestive of likely contamination of nearby surfaces. The effectiveness of arc barriers sheds light on arc propagation mechanisms.

N87-26954# ERA Ltd., Leatherhead (England). Applied Physics Dept.

#### RADIATION CHARGING AND BREAKDOWN OF INSULATORS

D. K. DAVIES In AGARD, The Aerospace Environment at High Altitudes and its Implications for Spacecraft Charging and Communications 7 p May 1987

Avail: NTIS HC A13/MF A01

An experimental investigation of the charge produced by photo-emission from insulators in vacuo is described. It is shown that the emission from materials commonly used in spacecraft construction, such as polyimide, as well described by solid state theory, but that externally applied fields modify both the emission dynamics as well as the eventual saturation charge density. The energetics of the electric breakdown of such charged surfaces is analyzed.

Author

N87-26957# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Community Satellites Dept.

# ELECTROSTATIC IMMUNITY OF GEOSTATIONARY SATELLITES

HORST G. LECHTE In AGARD, The Aerospace Environment at High Altitudes and its Implications for Spacecraft Charging and Communications 8 p May 1987

Avail: NTIS HC A13/MF A01

It is demonstrated that electrostatic immunity of telecommunication satellites can be achieved to a large extent by relatively simple means. Those means include the selection of antistatic external materials and the desensitization of electronic actuators and memories regarding fast transients. The dual approach is considered necessary because not all external surfaces can be made antistatic. Protection of operationally critical circuitries against single event upsets is achieved by the same means.

Author

#### 18

#### INTERNATIONAL

Includes descriptions, interfaces and requirements of international payload systems, subsystems and modules considered part of the Space Station system and other international Space Station activities such as the Soviet Salyut.

#### A87-32278

#### **EUROPE'S FUTURE IN SPACE**

MICHEL BIGNIER (ESA, Space Transportation Systems, Paris, France) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 1 . Tokyo, AGNE Publishing, Inc., 1986, p. 7-12.

The political, scientific, technical, industrial, and economic objectives of the European space program are discussed. The solar terrestrial program, X-ray and stellar spectroscopy studies, and asteroids missions are described. Consideration is given to earth observations, microgravity research, telecommunications, and the development of launchers. Studies on the in-orbit infrastructure for space stations are examined.

#### A87-32280

#### **BRITISH ACTIVITIES IN SPACE**

D. W. S. LODGE (British National Space Centre, London, England) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 1 . Tokyo, AGNE Publishing, Inc., 1986, p. 19-24.

British space activities and the involvement of British industry in national and international space programs are discussed. The composition and functions of the British National Space Centre are described. British contributions to the Ariane, Hotol, and Columbus programs; telecommunications; earth observation; and microgravity research are examined.

#### A87-32281

#### THE CANADIAN SPACE PROGRAM

D. I. R. LOW (Ministry of State for Science and Technology, Ottawa, Canada) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 1 . Tokyo, AGNE Publishing, Inc., 1986, p. 25-30.

The objectives of Canada's space program are examined and a review of Canada's space activities is presented. Canada's involvement in international space projects is discussed. Consideration is given to the Mobile Servicing Centre being designed for the proposed Space Station, Canada's research in space science, the formation of a corps of skilled astronauts, and telecommunications satellite and remote sensing activities.

#### A87-32282

### HIGHLIGHTS OF THE GERMAN SPACE PROGRAMME

JUERGEN W. BECK (DFVLR, Wessling, West Germany) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 1 . Tokyo, AGNE Publishing, Inc., 1986, p. 31-35.

The objectives of the major German space projects are discussed. Past activities in space-research and space-technology in manned and unmanned space programs are reviewed. Germany's launched or scheduled scientific, communications, meteorological, and earth observation satellites, and manned space flight activities are examined. Germany's contributions to the proposed ESA programs and U.S. Space Station program are considered.

#### A87-32285

#### JAPANESE SPACE PROGRAM

RYOJIRO AKIBA (Tokyo, University, Japan) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 1 . Tokyo, AGNE Publishing, Inc., 1986, p. 51-64.

This paper presents Japanese space activities with emphasis on aspects from the past two years. Introductory remarks outline the structure of space-related organizations and the basic principle for Japanese space activities. Among the scientific activities, the highlights in 1984-1986 are the launches of two spacecraft 'Sakigake' and 'Suisei' by M-3SII for Halley's comet exploration. In the field of practical applications, a meteorological satellite GMS-3 and a broadcasting satellite BS-2b were launched. The launch series includes the first launch of the H-I vehicle, which is characterized by the use of a cryogenic propellant for the second stage. In addition, the Space Activities Commission has approved two big projects: the development of the H-II launch vehicle and the participation to phase B activities in the U.S. Space Station program. Besides those prominent topics, major authorized programs are reviewed according to the newly revised space programs by the Space Activities Commission. Author

#### A87-32334

# PREDICTION OF RANDOM VIBRATIONAL RESPONSES OF A LARGE SPACECRAFT IN ACOUSTIC ENVIRONMENT BY BLPF METHOD

HIDEHIKO MITSUMA (National Space Development Agency of Japan, Tokyo), SHOJI MAEKAWA, TORU ITO (Kawasaki Heavy Industries, Ltd., Kakamigahara, Japan), TOSHIAKI TAKAHASHI, YUJI KUBOTA (Toshiba Corp., Kawasaki, Japan) et al. IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 1 . Tokyo, AGNE Publishing, Inc., 1986, p. 449-454.

The prediction of the random responses of a large model spacecraft consisting of honeycomb sandwich panels and component mass dummies to a reverberant acoustic field is studied using the Band-Limited Power Flow (BLPF) method. This method has the same characteristics as the Statistical Energy Method (SEM) in the high frequency domain and is applicable to prediction in the low frequency domain. The predictive results are compared with experimental ones, and good agreement is found. It is concluded that the BLPF method is effective for random response prediction for spacecraft.

#### A87-32335

# STRUCTURAL DESIGN AND COMPONENT TESTS OF LARGE GEOSTATIONARY SATELLITE BUS

HIDEHIDO MITSUMA, KUNIO NAKAMARU (National Space Development Agency of Japan, Tokyo), MASATAKA YAMAMOTO, KAZUMI OKUDA, and RYOICHI IMAI (National Space Development Agency of Japan, Tsukuba Space Center, Sakura) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 1 . Tokyo, AGNE Publishing, Inc., 1986, p. 455-464.

This paper presents the results of the structural design and major component tests of the Large Geostationary Satellite Bus for the application satellites in the 1990s. The satellite main structure is composed of a panel assembly. The mission, bus, and AKE tank support structures of the satellite are modularized.

Author

#### A87-32339

#### MODEL STUDY OF SIMPLEX MASTS

MICHIHIRO NATORI, MASAMORI SAKAMAKI, KORYO MIURA (Tokyo, University, Japan), KAKUMA OKAZAKI (Japan Aircraft Manufacturing Co., Ltd., Yokohama, Japan), and MASAKI TABATA (Mitsubishi Electric Corp., Central Research Laboratory, Amagasaki, Japan) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 1. Tokyo, AGNE Publishing, Inc., 1986, p. 489-496.

Large deformation properties of longerons and spacers of a coilable lattice mast for space applications are investigated. Some small models for laboratory experiments are manufactured and tested to get a fundamental understanding of the mechanism of a coilable lattice mast. Deformation patterns of a mast at each deployment stage are clearly shown, and the effects of material stiffness are also investigated.

#### A87-32341

# DEPLOYABLE SURFACE TRUSS CONCEPTS AND TWO-DIMENSIONAL ADAPTIVE STRUCTURES

MICHIHIRO NATORI, KORYO MIURA (Tokyo, University, Japan), and HIROSHI FURUYA (Nagoya University, Japan) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 1. Tokyo, AGNE Publishing, Inc., 1986, p. 503-508. refs

Various conceptual considerations for both flat and curved deployable truss structures based on the collapsible transformations of polyhedral truss elements are presented from the viewpoint of geometry. Various deployable octet elements are investigated for systematic interpretations of deployable surface truss structures. The new possibility for two-dimensional adaptive structures with controllable geometry is also studied.

#### A87-32346

# ENHANCEMENT OF SOLAR ABSORPTANCE DEGRADATION DUE TO CONTAMINATION OF SOLAR RADIATOR PANELS IN GEOSYNCHRONOUS ORBIT - CORRELATION OF FLIGHT DATA AND LABORATORY MEASUREMENTS

FRANCOIS LEVADOU, KEITH DERBYSHIRE (ESA, European Space Research and Technology Centre, Noordwijk, Netherlands), and ALAIN PAILLOUS (ONERA, Centre d'Etudes et de Recherches de Toulouse, France) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 1 . Tokyo, AGNE Publishing, Inc., 1986, p. 535-542. refs

The results of contamination/degradation tests and of a preliminary analysis of 2.5 years of operation of the Thermal Housekeeping Package (THP) aboard ECS-1, ESA's telecommunications satellite, are presented. Tests for UV and particle irradiation performed before the launch of ESA's Orbital Test Satellite (OTS), a forerunner of ECS-1, are briefly reviewed, and the irradiation and housekeeping tests undertaken after the OTS degradation analysis are discussed. The analysis of the degradation/contamination of the Optical Surface Reflector (OSR) and the ECS-1 is addressed. An enhancement of solar absorptance degradation due to contamination of OSR was clearly demonstrated by ground tests.

#### A87-32368

# THERMAL VERIFICATION METHOD FOR LARGE SIZED SPACECRAFT

SATOSHI HAYASHIGUCHI, TATSUSABURO NAKAMURA (Kawasaki Heavy Industries, Ltd., Technical Institute, Akashi, Japan), AKIRA OHNISHI, and TOMONAO HAYASHI (Tokyo, University, Japan) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 1. Tokyo, AGNE Publishing, Inc., 1986, p. 697-702

Space exploration in recent years has made possible the transport of a large payload with a large-sized vehicle, motivated by the advent of the Shuttle, which is encouraging the use of space for a host of new activities. As it becomes difficult to make a thermal balance test on the full scale necessary for thermal design with the enlargement of spacecraft, thermal balance test by a divided module is preferable and an experiment was conducted to develop this method. The modular test method divides a spacecraft into plural modules and makes a thermal balance test for each module, to evaluate the thermal design of a full-scale spacecraft. It arises in this method that a part of each divided module makes another heat exchange between its divided face and the chamber shroud. To solve this, a method of simulating the quantity of radiative heat exchange between each module by means of an infrared panel was adopted. In order to confirm the propriety of this modular test method, a thermal balance test using a simple box-shaped model was made, and good agreement was attained between the estimated temperature of the full-scale model obtained from the modular test method and the measured temperature of the full-scale model.

#### A87-32370

## DEVELOPMENT OF FLUID LOOP SYSTEM FOR SPACECRAFT

MASAO FURUKAWA, YASUO NAKAMURA, RYOUICHI IMAI (National Space Development Agency of Japan, Sakura), TAKAHIRO KOMATSU, KIYOSHI TANAKA (NEC Corp., Yokohama, Japan) et al. IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 1 . Tokyo, AGNE Publishing, Inc., 1986, p. 711-716.

This paper describes experimental results on the stability of temperature control for a single-phase fluid loop system being developed for possible use of a large geostationary satellite and a free-flyer. The developed model has 200 W of heat removal capacity and a weight of 20 Kg. As a result of temperature control via a bypass valve, the temperature of the cold plates arranged in series can be controlled within + or 3.0 C, and, in case of cold plates arranged in parallel, control is within + or - 3.5 C.

Author

#### A87-32388

# LABORATORY SIMULATION OF PLASMA INTERACTION WITH HIGH VOLTAGE SOLAR ARRAY

HARUHISA FUJII, YOSHIKAZU SHIBUYA (Mitsubishi Electric Corp., Amagasaki, Japan), TOSHIO ABE, KOICHI IJICHI, RITAROH KASAI (Mitsubishi Electric Corp., Kamakura, Japan) et al. IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 1. Tokyo, AGNE Publishing, Inc., 1986, p. 825-830. refs

The interactions of solar arrays operating at a high voltage with dense plasma are investigated. Glass-covered aluminum plates simulating the solar arrays were subjected to dc potentials in a plasma-filled space chamber. When negative voltage was applied, arcing discharge occurred at the voltage less than 1000 V. The breakdown voltage decreased with increasing plasma density. The existence of the insulating cover glasses is found to lower the discharge voltage. In the case of positive polarity, however, no discharge occurred at the potential up to 1000 V.

#### A87-32456

#### DEVELOPMENT OF CARBON DIOXIDE REMOVAL SYSTEM -EXPERIMENTAL STUDY OF SOLID AMINES

KIYOSHI HIGUCHI (National Space Development Agency of Japan, Tokyo), SHUJI KANDA, HIROYUKI MATSUMURA, HIROAKI FUJIMORI, TAKATOSHI SHOJI (Kawasaki Heavy Industries, Ltd., Kobe, Japan) et al. IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 1343-1348. Research supported by the National Space Development Agency of Japan. refs

This paper describes the carbon dioxide removal system in the Environmental Control and Life Support System for the Japanese Experiment Module of the Space Station. A solid amine, carbon dioxide removal substrate is under development at present to replace the consumptive adsorbent (LiOH). It is characterized by a regenerative agent which makes it possible to adsorb and desorb repeatedly. The other systems such as the electrochemical depolarized carbon dioxide concentration system and molecular sieves carbon dioxide removal system are also being developed.

Author

### A87-32475

### SYSTEM AND OPERATION ANALYSES OF OTV NETWORK -A NEW SPACE TRANSPORTATION CONCEPT

TORU TANABE (Tokyo, University, Japan), SINICHI NAKASUKA, and TAKANORI IWATA IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 1475-1480. refs

A space transportation system concept, OTV Network, is proposed, integrating space-based unmanned reusable OTVs and a set of fuel stations on earth orbits. The ability to enhance single OTV capability, the smallness of the expendable part, and the ability to separately launch OTVs and fuel supplies, increase flexibility and cost effectiveness. A new scheduler is also proposed which adopts a built-in simulator to cope with the many parameters to be set in the scheduling process. Off-nominal situations including emergent missions and OTV failures are also discussed.

R.R.

#### A87-32507

# OBSERVATION OF PRECIPITATION FROM SPACE BY THE WEATHER RADAR

KENICHI OKAMOTO, HARUNOBU MASUKO, SHIN YOSHIKADO (Ministry of Posts and Telecommunications, Radio Research Laboratory, Koganei, Japan), KENJI NAKAMURA, MASAHARU FUJITA (Ministry of Posts and Telecommunications, Radio Research Laboratory, Kashima, Japan) et al. IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 1711-1720. refs

Progress to date on the development of a spaceborne active microwave weather radar by the Japan Radio Research Laboratory is summarized. The experiments have included joint operation with

NASA of an airborne microwave rain scatterometer/radiometer functioning in the X- (9.86 GHz) and Ka-bands (34.45 GHz). Features and performance of the jointly operated system are described, including the scanning patterns explored, the principal characteristics of the radiometers, and data processing and display subsystems, which furnished quick-look color imagery for viewing within the aircraft. Results are reported from comparisons of the rainfall rate estimates obtained with a least-squares method with equivalent data from a ground-based C-band radar, and from measurements of rainfall over the ocean in terms of the attenuation coefficient. Preliminary specifications are provided for a spaceborne weather radar system.

#### A87-32528

# SPACE STATION - OVERVIEW OF THE EUROPEAN CONCEPT OF COLUMBUS PROGRAMME STATUS AND CONTENT

R. MORY (ESA, Paris, France) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2 . Tokyo, AGNE Publishing, Inc., 1986, p. 1891-1896.

Europe's role in the development of the Space Station is discussed. Consideration is given to the status of the Columbus program. The design and development of a pressurized module, polar platform, service vehicle, and resource module for the Space Station are examined.

#### A87-32530

# SPACE STATION PROGRAM IN A LONG-RANGE SPACE DEVELOPMENT SCENARIO OF JAPAN

YOSHIAKI OHKAMI (National Aerospace Laboratory, Chofu, Japan) and MASAHIRO KAWASAKI (Science and Technology Agency, Research Coordination Bureau, Tokyo, Japan) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 1905-1908.

An overview on the Japanese participation in the Space Station Program is presented in conjunction with long-range space development and utilization programs for the future. Based on the recognition that space utilization has eventually entered a new era, a large-scale and long-range scenario is depicted. Most important of all are the commercialization of space environment utilization and expansion of areas for human activities. This tends to support urgent development of space utilization technologies and manned space technologies, as well as development of efficient access means to the space environment. Participation in the International Space Station Program is one of the most appropriate options to realize the final goal.

#### A87-32531

## STATUS OF JAPANESE EXPERIMENT MODULE DESIGN

Y. MORISHITA, M. SAITOU, K. HIGUCHI, and K. SHIRAKI (National Space Development Agency of Japan, Tokyo) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2 . Tokyo, AGNE Publishing, Inc., 1986, p. 1909-1913.

This paper describes the detailed definition and preliminary design (phase-B study) status of the Japanese Experiment Module (JEM), which is a Japanese contribution to the international Space Station (SS) program. The first half of the phase-B study of JEM was completed successfully in March 1986, and JEM primary functions and basic configuration have been established. Based upon the results of these efforts, official notification to conduct preliminary design of JEM was sent from the minister of Science and Technology Agency of Japan to the NASA administrator on March 10.

#### A87-32532

# DEVELOPMENT OF EXPOSED DECK OF JAPANESE EXPERIMENT MODULE

KUNIAKI SHIRAKI, YOSHINORI YOSHIMURA (National Space Development Agency of Japan, Tokyo), JUNZO TANAKA, TOSHIHIKO OHTA, HITOSHI TEZUKA (Nissan Motor Co., Ltd., Aeronautical and Space Div., Tokyo, Japan) et al. IN: International

Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2 . Tokyo, AGNE Publishing, Inc., 1986, p. 1915-1919.

Results are presented from a baseline trade-off study on sizing and concepts for the exposed structure for the Japanese experiment module (JEM) to be attached to the Space Station. The multipurpose facility will be approximately 3.3 x 1.4 x 2 m in size and will be carried into orbit on the Shuttle. The device will accommodate payload changeouts by the RMS and is to have a lifetime of 10 yr. Structural design criteria to ensure a harmonious interface with the Space Station and Shuttle are summarized, noting that a frame structure is the leading candidate for the final configuration. Extensive use will be made of CFRP materials for high stiffness, strength, and good thermal expansion characteristics.

#### A87-32534 AN ENCLOSED HANGAR CONCEPT FOR LARGE SPACECRAFT SERVICING AT SPACE STATION

YOSHIAKI OHKAMI, KOHTARO MATSUMOTO, TAKASHI KIDA (National Aerospace Laboratory, Chofu, Japan), TAKASHI IIDA (Ministry of Posts and Telecommunications, Radio Research Laboratory, Koganei, Japan), and JIRO SAKAI (Ohbayashi Corp., Tokyo, Japan) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 1939-1944.

Two configurations for a large inflatable enclosed-space pressurized hangar being designed as a Space Station element for the purpose of providing a working area for semi-EVA spacecraft servicing are discussed. The hangar will be large enough to enable crews to assemble, measure, and repair such large structures as a 10-m class antenna planned for the Large Antenna Assembly and Measurement Experiment to be performed at the Japanese Experiment Module at the Space Station. A brief feasibility study on the large structure, the skin materials, and the operations management is presented with emphasis placed on the maintenance of pressure and temperature and the volume of the required air, identifying some technology problems that need to be resolved.

#### A87-32535 SOLAR CONCENTRATOR SYSTEM FOR EXPERIMENTS IN THE SPACE STATION

YOSHIHIRO NAKAMURA, HISAO AZUMA (National Aerospace Laboratory, Chofu, Japan), KUNIHIKO KAWAKAMI, and TATSUYA HAMAGUCHI (Mitsubishi Electric Corp., Communication Equipment Works, Amagasaki, Japan) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 1945-1950 refs

The results of a preliminary study of the solar concentrator system (SCS), which will be used for experiments aboard the Space Station, are presented. The SCS, scheduled for launch in 1994 after the Space Station will have been positioned in LEO, is designed to make it possible to conduct experiments in the fields of material science, life science, space technology, and space energy. The features of these experiments are described along with a design study of the SCS elements which will make it possible to perform these experiments, such as the solar flux concentrating device, the primary and secondary reflectors, the shutters, the optical systems, and the solar energy transmitting device. A deployable truss beam and a pointing mechanism will make it possible to place the SCS in a location away from the pressurized module and to orient it toward the sun during one half of each orbit. Design diagrams are included.

#### A87-32537

EURECA - A FIRST STEP TOWARDS THE SPACE STATION ROBERT MORY (ESA, Paris, France) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2 . Tokyo, AGNE Publishing, Inc., 1986, p. 1957-1963.

The European Retrievable Carrier (Eureca) is designed for Shuttle launch to LEO, self-boost to a 525 km orbit, 6-9 mos on-station, then return to LEO for Orbiter retrieval. Eureca will provide a long-duration undisturbed 0.00001 g environment, reusable hardware (up to five times), and high power and mass capability for the payload. The design includes the SPAS truss structure, the Spacelab cooling system, bubble memory and a modular attitude control system. Two 7 m solar arrays will furnish 1 kW continuous (1.5 kW peak) power backed up to NiCd batteries. Orbit transfer will be achieved with redundant hydrazine-fueled boosters, and data transmission is to be by relay through the Olympus satellite to ESOC headquarters. The progression of missions envisioned and scheduled for Eureca includes baseline experiments, microgravity research, astronomy, solar physics, and earth remote sensing. Eventually, the Eureca design will be used for coorbiting and noncoorbiting platforms as part of the Space Station system.

# A87-32539 CONCEPT DESIGN AND COST ESTIMATION OF A FREE-FLYING SPACE PLATFORM

MAKOTO NAGATOMO (Tokyo, University, Japan) and TAKASHI NAKAJIMA (Hitachi, Ltd., Satellite Systems Dept., Yokohama, Japan) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 1971-1976.

Preliminary studies have been made for a free-flyer type of general-purpose facility to be released from and retrieved by the Space Shuttle. A reference model of the free-flying facility is the SFU, which accommondates payloads in six boxes called Payload Units and provides them with electrical power, thermal control, and data-management services. A Payload Unit is capable of installing payload with the maximum mass of 200 kg and supplying an average electrical power of 160 W. Two types of standard missions are considered. One is the STS-tended mission, and the other is the automated mission. A mission model for material processing consists of four flights: two STS-tended and two 3-month automated missions. A cost model for the reference model has been developed and used to estimate costs for experiments included in this mission model. The result shows that, since the STS operation is a dominant portion of mission operation costs, the cost-benefit approach is most important for experiment planning.

# A87-32540 PAYLOAD BOOMERANG TECHNOLOGY FOR SPACE EXPERIMENTS AT VERY LOW GRAVITY LEVEL

AKIRA ONJI, YASUTOSHI INOUE, SHIGEAKI NOMURA, TAKASHI KIDA, and SHOICHI TSUDA (National Aerospace Laboratory, Chofu, Japan) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 1977-1982.

The payload boomerang satellite (PBS) is proposed for 10 hr g-litter free microgravity experiments from a Space Station base. The PBS would be launched from the vicinity of the Station and would follow a passive trajectory to return to the Station. The spacecraft would have an aerodynamic umbrella for passive drag to control the trajectory relative the Station. Analytical models are presented for precise control of the trajectory. The models account for solar wind effects, aerodynamic effects and the effects of the solar panels on the Space Station orbit, and yield the launch velocity, recovery velocity and the range of the trajectories. A second-order analysis carried out with the model would yield 4 m accuracy for a 4 hr mission, and efforts are under way to perform a third order analysis which provides 1 m accuracy for a 10 hr mission. The PBS could also be used for performing experiments which will release gases which cannot be tolerated near the Space M.S.K. Station.

# A87-32541 AUTONOMOUS DECENTRALIZED SYSTEM CONCEPT FOR SPACE STATION

TOSHIYUKI TANAKA, KUMIKO TAKIKAWA, AKIRA ASHIDA,

SATOSHI MOHRI (Hitachi, Ltd., Space Systems Div., Yokohama, Japan), KINJI MORI (Hitachi, Ltd., Systems Development Laboratory, Kawasaki, Japan) et al. IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2 . Tokyo, AGNE Publishing, Inc., 1986, p. 1983-1988.

The Autonomous Decentralized System (ADS) is described for the Space Station data management and control system. ADS is configured to satisfy the fault tolerance, modularity, extensibility, and maintainability requirements of the Station. The concept is based on the design of living beings, which always have faulty parts, change constantly, and accomplish objectives. The changes are between operation, maintenance, and growth. ADS integrates autnomous subsystems which coordinate their activities with other subsystems if other subsystems fail. No priority is given any information in the data management system. The data flow is outward successively through every point in the system. Subsystems select data of interest, which requires the system to be semantics-, rather than syntax-based. Implementation of the concept in an autonomous decentralized loop is described, including the use of autnomous multimicrocomputers to enhance the reliability and flexibility of the system.

#### A87-32542 Japanese experiment module data management And communication system

ISAO IIZUKA (National Space Development Agency of Japan, Tokyo), HARUMITSU YAMAMOTO, MINORU HARADA, IWAO EGUCHI, MASAMI TAKAHASHI (NEC Corp., Yokohama, Japan) et al. IN: International Symposium on Space technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 1989-1994.

The data management and communications system (DMCS) for the Japanese experiment module (JEM) being developed for the Space Station is described. Data generated by JEM experiments will be transmitted via TDRS (primary link) to the NASDA Operation Control Center. The DMSC will provide data processing, test and graphics handling, schedule planning support, and data display and facilitate subsystems, payloads, emergency operations, status, and diagnostics and healthchecks management. The ground segment includes a mainframe, mass storage, a workstation, and a LAN, with the capability of receiving and manipulating data from the JEM, the Space Station, and the payload. Audio and alert functions are also included. The DMCS will be connected to the interior of the module with through-bulkhead optical fibers.

M.S.K.

### A87-32546

A MASTER-SLAVE MANIPULATOR SYSTEM FOR SPACE USE Y. TODA, K. MACHIDA, T. IWATA, K. NAKAYAMA (Ministry of International Trade and Industry, Electrotechnical Laboratory, Sakura, Japan), J. NAKAGAWA (Mitsubishi Electric Corp., Kamakura, Japan) et al. IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2. Tokyo, AGNE Publishing, Inc., 1986, p. 2023-2028.

Design principles are defined for master-slave robotic manipulator systems (MRMS) for space applications, and tests of prototype embodiments of the principles are described. MRMS systems have a main arm and several slave arms, each with an independent control system, a data transmit rate of 300 kbps and a RS-422 serial port communication link. The console controller or the master arm end effector transmit position coordinates which are followed by the slave arms. The logic employed in determining the master manipulator position, path and torque and transmitting and converting the signals to slave arms and their effectors is outlined. Features of scale model master and slave MRMS are delineated, noting that controllers for both units employed MC68000 chips for high processing speed and low power consumption, and optic fibers for data transmission. Data from tests of the prototype systems are discussed in terms of problems in the controller logic and the performance in vacuum and atmospheric conditions.

M.S.K

#### A87-32547

# DEVELOPMENT OF SENSORS FOR REMOTE MANIPULATOR SYSTEM OF JAPANESE EXPERIMENT MODULE

NAOYA EZAWA, NAOKI NOGUCHI, and HIROMI AJIMA (Hitachi, Ltd., Space Systems Div., Yokohama, Japan) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2 . Tokyo, AGNE Publishing, Inc., 1986, p. 2029-2034.

The JEM (Japanese experiment module) is to be supported in service by small and large remote manipulator systems, each with six degrees of freedom. Rotary encoders that will be mounted at the axis of each joint actuator to measure angular velocity are described, along with laser spot proximity sensors at the top of the gripper. The small arm will be controlled by force-feedback bilateral master-slave control and will have a six-axis force sensor between small fine arm and the gripper to monitor forces and moments on the arm. The arms will move in response to human movements of a master arm within the pressurized module. A detailed discussion is presented of the six axis force sensor which will provide feedback to the master arm controller. Finally, design and development problems still to be overcome are identified.

Author

#### A87-32655

# AN ASSESSMENT OF RECENT ADVANCES IN MODELING AND CONTROL DESIGN OF SPACE STRUCTURES UNDER UNCERTAINTY

HAGOP V. PANOSSIAN (HR Textron, Inc., Valencia, CA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 13-16, 1986. 9 p. refs (SAE PAPER 861818)

Uncertainty due to modeling approximations, random noise and tolerances in components, parametric and other errors in space structure modeling and control design create the need for stochastic representations. A short survey of different approaches to modeling of large flexible space structures under uncertainty is presented in the present article. Advantages and disadvantages of various modeling procedures for analysis and control design are briefly discussed and a novel approach is presented that incorporates statistical information in the best available mathematical model, and thus generates a realistic stochastic model for the structure. Moreover, difficulties relative to modeling, testing, validation, and verification in space structures are underlined and discussed.

### A87-32801

# GRAVITY-GRADIENT STABILIZATION OF THE SALYUT 6-SOYUZ ORBITAL COMPLEX

G. M. GRECHKO, V. A. SARYCHEV, V. P. LEGOSTAEV, V. V. SAZONOV, and I. N. GANSVIND (Kosmicheskie Issledovaniia, vol. 23, Sept.-Oct. 1985, p. 659-675) Cosmic Research (ISSN 0010-9525), vol. 23, no. 5, March 1986, p. 515-527. Translation. refs

A study is reported that uses the equations of motions of Sarychev and Sazonov (1981, 1985) for processing the measurements of several motion parameters obtained by cosmonaut Grechko aboard the orbital complex Salyut 6 and Soyuz spacecraft. Three series of measurements were made, two related to motion of the satellite under conditions of gravity-gradient stabilization and the other related to unstabilized motion. The purpose was to show that microaccelerations acting onboard the satellite are minimal under conditions of gravity-gradient stabilization. By using different methods to process these measurements, several real motions of the satellite were reconstructed and the satellite aerodynamic parameters were determined.

#### A87-32814

CONTRIBUTION OF THE GERMAN DEMOCRATIC REPUBLIC (EAST GERMANY) TO THE 'INTERCOSMOS' PROGRAM OF STUDY OF MATERIALS IN SPACE ABOARD THE ORBITING STATION SALYUT 6

J. BARTHEL and R. KUHL (Kosmicheskie Issledovaniia, vol. 23, Sept.-Oct. 1985, p. 783-791) Cosmic Research (ISSN 0010-9525), vol. 23, no. 5, March 1986, p. 611-618. Translation. refs

Several international projects involving the space studies of materials in 1978 and 1980 are recounted. Project Berolina was a joint USSR-East German project with East German cosmonaut Sigmund Jena aboard the satellite Salyut-6. Subsequent tests (in Projects Halong and Imitator) also included Vietnamese scientists. Experiments described cover: growth of BiSb crystals, smelting of glass, transport of germanium in the gaseous phase, guided crystallization of PbTe, guided crystallization of BiSb, guided crystallization of BiSbTe, and measurement of temperature distribution in identical ground-based and space ovens.

#### A87-32815 INSTABILITY OF AN ELASTIC FILAMENT IN ORBIT AROUND A GRAVITATING CENTER

A. I. MOROZOV and A. M. FRIDMAN (AN SSSR, Astronomicheskii Sovet, Moscow, USSR) (Zhurnal Tekhnicheskoi Fiziki, vol. 56, June 1986, p. 1065-1074) Soviet Physics - Technical Physics (ISSN 0038-5662), vol. 31, June 1986, p. 623-628. Translation. refs

A general equation is described for the motion of a perfectly flexible heavy filament in an external force field; the result is used to derive equations for arbitrary small perturbations in the motion of a filament in orbit around a gravitating center. Analysis of these equations shows that there is a wide range of equilibrium parameters for which the amplitude of all modes with m not equal to 0 increases and the motion becomes unstable. The instability stems from the presence of an elastic force, which causes the perturbed parts of the filament moving along orbits of unequal radius to revolve at the same angular frequency, so that the part of the filament farthest from the gravitating center is accelerated and moves farther away, while the inner portion moves closer to the gravitating center. This stretches the filament further, the elastic force increases, and the system becomes unstable. The results also apply to sufficiently flexible extended (but not necessarily closed) elastic objects that are oriented along the orbit. Two examples are considered: a metal filament in near space, and elongated ice 'needles' in Saturn's rings. The effective time for instability to develop is estimated. In the first case it is comparable to the time for one orbital revolution around the earth, while in the second case it is roughly equal to five orbital periods around Saturn. It is suggested that a computer-controlled feedback and servo system might be used to stabilize the motion.

# A87-32819 CRITICAL LENGTH FOR STABLE ELONGATED ORBITING STRUCTURES

N. N. GORKAVYI, A. I. MOROZOV, and A. M. FRIDMAN (AN SSSR, Astronomicheskii Sovet, Moscow, USSR) (Zhurnal Tekhnicheskoi Fiziki, vol. 56, June 1986, p. 1210-1213) Soviet Physics - Technical Physics (ISSN 0038-5662), vol. 31, June 1986, p. 711-713. Translation. refs

The stabilizing effects of rigidity combined with tension are analyzed and the critical length for a stable section of rod lying tangent to the orbit are calculated. An example of elastic Euler instability for three-dimensional orbiting objects is provided. It is shown that, in large orbiting systems, the lengths of the rods tangent to the orbit and perpendicular to the orbital plane must satisfy certain conditions if they are to be stable. The precise form of these conditions depends on both the rigidity and tension on the rods.

# A87-33667# ADAPTIVE PLANAR TRUSS STRUCTURES AND THEIR VIBRATION CHARACTERISTICS

MICHIHIRO NATORI (Tokyo, University, Japan), KAZUO IWASAKI (National Aerospace Laboratory, Chofu, Japan), and FUMIHIRO KUWAO (Toshiba Corp., Aerospace Equipment Div., Kawasaki, Japan) IN: Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical

Papers. Part 2A . New York, American Institute of Aeronautics and Astronautics, 1987, p. 143-151. refs (AIAA PAPER 87-0743)

The structural concept of adaptive planar space truss structures is evaluated from the viewpoints of both geometrical adaptivity and dynamic characteristics. Some geometrical properties of a function model are also presented to demonstrate the effectiveness of the concept.

Author

### A87-34047

ON THE DYNAMICAL STABILITY OF THE SPACE 'MONORAIL' S. BERGAMASCHI and D. MANNI (Padova, Universita, Padua, Italy) IN: International Conference on Nonlinear Mechanics, Shanghai, People's Republic of China, Oct. 28-31, 1985, Proceedings Beijing, Science Press, 1985, p. 1165-1170. refs

The dynamical stability of 'monorail' tethered-satellite/elevator configurations being studied for the Space Station is investigated analytically, treating the end platforms and elevator as point masses, neglecting tether elasticity, and taking the Coriolis force and the complex gravitational field into account in analyzing the orbital-plane motion of the system. A mathematical model is constructed; the equations of motion are derived; and results obtained by numerical integration for platform masses 100,000 and 10,000 kg, elevator mass 5000 kg, and a 10-km-long 6-mm-diameter 4070-kg-mass tether are presented in graphs and briefly characterized.

#### A87-34207

CHOICE OF THE OPTIMAL ANGULAR POSITION OF A SPACECRAFT IN THE CONSTANT-SOLAR-ORIENTATION FLIGHT SEGMENT (VYBOR OPTIMAL'NOGO UGLOVOGO POLOZHENIIA KOSMICHESKOGO APPARATA NA UCHASTKE POSTOIANNOI SOLNECHNOI ORIENTATSII)

A. M. IANSHIN Kosmicheskie Issledovaniia (ISSN 0023-4206), vol. 25, Jan.-Feb. 1987, p. 23-29. In Russian.

The orientation which assures minimum angular momentum due to gravitational and magnetic disturbances is determined for a typical spacecraft with solar panels (e.g., Soyuz or Mir). These disturbances are assumed to act on the spacecraft in an arbitrary unshaded orbit for maximum illumination of the solar panels. Attention is given to cases when the panels are fixed rigidly to the spacecraft and rotate with respect to a single axis.

## A87-34208

OPTIMIZATION OF A PROGRAM OF EXPERIMENTS IN CONNECTION WITH THE OPERATIONAL PLANNING OF STUDIES CARRIED OUT WITH A SPACECRAFT [OPTIMIZATSIIA PROGRAMMY EKSPERIMENTOV PRI OPERATIVNOM PLANIROVANII ISSLEDOVANII, VYPOLNIAEMYKH S KA]

M. IU. BELIAEV and D. N. RULEV Kosmicheskie Issledovaniia (ISSN 0023-4206), vol. 25, Jan.-Feb. 1987, p. 30-36. In Russian.

An approach to the optimal planning of experiments for the Salyut orbital station is described. The problem of operational experiment planning is reduced to an integer problem of linear programming. A set of programs for the BESM-6 computer has been developed for implementing the proposed method. The remote sensing of earth resources is considered as an example.

#### A87-34345

SHAPE CONTROL OF THE DIRECTIONAL PATTERN IN A MICROWAVE-BEAM POWER TRANSMISSION CHANNEL [UPRAVLENIE FORMOI DIAGRAMMY NAPRAVLENNOSTI V TRAKTE PEREDACHI ENERGII SVCH-PUCHKOM]

V. A. VANKE, S. K. LESOTA, and A. V. RACHNIKOV Radiotekhnika (ISSN 0033-8486), Jan. 1987, p. 70-73. In Russian.

It is demonstrated that it is possible to control the position of the field-intensity peak in the highly efficient microwave power transmission channel in a satellite solar power system. A channel having a directional pattern with an intensity dip on the beam axis is characterized by a high utilization coefficient (up to 0.58) of the receiving antenna and high levels of transmitted power. High values of channel efficiency (greater than 90 percent) are observed for values of the wave parameter tau greater than 3.

B.J.

#### A87-34594

## INTERNATIONAL COOPERATION IN SPACE

CRAIG COVAULT Commercial Space (ISSN 8756-4831), vol. 2, no. 4, Winter 1987, p. 16-19.

High costs and potential benefits of space activities are beginning a new era of global partnerships, with international space competition remaining important but gradually giving way to international cooperation. French Spot Earth resources satellite images are being marketed worldwide, the European Ariane booster has a 50 percent share of the world launch market, and the People's Republic of China is attracting international payloads for launch from its Xichang site. International participation on spaceflights is increasing, both on the Soviet Soyuz, Salyut and Mir spacecraft and on the U.S. Shuttles. The international Halley armada is another example of global cooperation. The international space picture is changing because of a new technologies in many nations, and the involvement of more countries (India, China, Japan, the Europeans). Five UN space treaties are in force, and a high degree of space cooperation for the 1990's seems likely.

# A87-34595 ADVANCES BY THE SOVIET UNION IN SPACE COOPERATION AND COMMERCIAL MARKETING MADE 1986 A LANDMARK YEAR

JEFFREY M. LENOROVITZ Commercial Space (ISSN 8756-4831), vol. 2, no. 4, Winter 1987, p. 20-22.

A review is presented of the Soviet Union's new campaign for openness as it applies to planned space missions, new cooperation in space, and commercial marketing moves made public during 1986. It was exemplified when the head of the Soviet's Space Research Institute addressed an audience in the Sistine Chapel in 1986 giving detailed findings of the two Vega spacecraft from their encounter with Halley's comet. The Soviet Union is planning a Mars/Phobos mission in 1988, using two spacecraft on Proton launch vehicles. Other missions in the planning phase include Vesta flights to Mars and asteroid/comet targets in the 1990s and a lunar polar orbiter; the Vesta mission was proposed by France as one that could be conducted in cooperation with ESA. Solar-terrestrial missions - Interbol, Prognoz, Relicht 2 - are mentioned. Cooperative space science opportunities are being offered aboard Mir - a large modular manned space station operational in 1987. Commercially, the Soviets are prepared to orbit the Gorizont satellite, with six 6/4-GHz transponders, one 14/11-GHz transponder, and a 1.6/1.5-GHz transponder, and lease its communications capacity to a commercial user. Proton launch vehicle services for communications satellites are being offered at the rate of \$24 millin per metric ton (\$43 million for two tons), payable in Swiss francs.

#### A87-34874

## MECHANICAL DESIGN OF THE EUROSTAR PLATFORM

K. HECKS (British Aerospace, PLC, Space and Communications Div., Stevenage, England) British Interplanetary Society, Journal (Space Chronicle) (ISSN 0007-084X), vol. 40, March 1987, p. 133-139.

Eurostar is a Communications S/c Platform developed by British Aerospace and Matra. It is designed to be compatible with Ariane 4/SPELDA and STS/PAM and usable for a range of possible missions. This paper discusses the mechanical design of the platform. This includes the overall configuration, the use of a 4-tank Combined Propulsion Subsystem, the Structure with CFRP central thrust tube, the Solar Array Drive and provisions for the Solar Array, and the Thermal Control.

# A87-35076# DEVELOPMENT OF HARMONIC DRIVE ACTUATOR FOR SPACE MANIPULATOR

TOSHIAKI IWATA, KAZUO MACHIDA, and YOSHITSUGU TODA

Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 34, no. 395, 1986, p. 652-660. In Japanese, with abstract in English. refs

This paper presents the development of a harmonic drive actuator which features vacuum environment durability and the light-weight for a 1-m class space manipulator. A tribological study of bearings and gears is carried out experimentally. Some candidate materials and lubricants are tested in a vacuum chamber, and the wear properties are investigated. The ball bearing with MoS2-sputtered ball and race and a PTFE composite retainer had excellent characteristics and lifetime. An operation lifetime over 1,000 hours was attained for the harmonic gear by employing a nitrided steel spline and a PFPE grease. An actuator with a high torque/weight ratio, which was integrated with a rare-earth brushless servo motor, an optical encoder, drive electronics, and a harmonic gear compactly, was developed.

# A87-35077# A STUDY ON SINGULARITY OF SINGLE GIMBAL CMG SYSTEMS

HARUHISA KUROKAWA and NOBUYUKI YAJIMA Japan Society for Aeronautical and Space Sciences, Journal (ISSN 0021-4663), vol. 34, no. 395, 1986, p. 661-666. In Japanese, with abstract in English. refs

A single gimbal CMG system is a promising candidate for an actuator of attitude control systems for large space structures. One of its problems is the existence of singular states. Various steering laws assume redundancy in the system and avoid singular states by maximizing a certain criterion function value by a gradient method. But it is not theoretically clear whether these steering laws can actually avoid all singular states. In this paper, a quadratic form is defined for each singular state, which enables to classify singular states into three types. In the vicinity of two types of singular states, escape from the vicinity is not guaranteed locally. Also it is difficult to guarantee that the system does not go into the vicinity of any two types of singular points by using the gradient method only. Examples of the three types of singular states are shown for three configurations.

# A87-35877 PROBLEMS OF MECHANICAL SYSTEM CONFIGURATION CONTROL [ZADACHI UPRAVLENIIA KONFIGURATSIEI MEKHANICHESKOI SISTEMY]

L. M. ARTIUSHIN (Kievskoe Vysshee Voennoe Aviatsionnoe Inzhenernoe Uchilishche, Kiev, Ukrainian SSR) Prikladnaia Mekhanika (ISSN 0032-8243), vol. 23, Feb. 1987, p. 89-95. In Russian. refs

The problem of the configuration control of mechanical systems is analyzed using the method of inverse dynamics problems and a game theory approach. It is shown that the method of inverse dynamics problems makes it possible to resolve the difficulties associated with the determination of control law parameters on the basis of game theory. Control functions of the system elements are obtained analytically. For the algorithmic implementation of the control functions, a rigorous procedure is presented for determining the control law coefficients.

#### A87-37853

# AUTOMATIC GENERATION OF STOCHASTICALLY DOMINANT FAILURE MODES FOR LARGE-SCALE STRUCTURES

YOSHISADA MUROTSU, SATOSHI MATSUZAKI, and HIROO OKADA (Osaka Prefecture, University, Sakai, Japan) JSME International Journal (ISSN 0913-185X), vol. 30, Feb. 1987, p. 234-241. refs

This paper proposes a branch-and-bound technique which generates stochastically dominant structural failure modes by using a lower bound of the complete failure path probability. Combinatorial properties of the failure paths are clarified and it is shown that there are many complete failure paths in a large-scale structure with a high degree of redundancy. Then, in order to reduce the number of computations, heuristic operations are applied to the branch-and-bound algorithm. Finally, the validity of the heuristic operations is demonstrated through numerical examples. Author

#### A87-37962

## THE EUROPEAN SPACE PROGRAMME

Space Policy (ISSN REIMAR LUEST (ESA, Paris, France) 0265-9646), vol. 3, Feb. 1987, p. 2-4.

The current objectives of ESA are described. Consideration is given to the development of the Ariane 5 launcher, the Columbus program, and activities in the fields of space science, earth observations, telecommunications, and microgravity. Advances in the areas of in-oribt infrastructure and space transportation systems are examined; particular attention is given to Hermes and the Columbus program. The benefits provided by international cooperation in the exploration of space are discussed.

## FLUNKING ON SPACE STATION COOPERATION?

WULF VON KRIES (DFVLR, Washington, DC) Space Policy (ISSN 0265-9646), vol. 3, Feb. 1987, p. 10-12.

The relationship between the U.S. and Europe concerning the development of the permanently manned Space Station is examined. The advantages of international cooperation in the construction of the Space Station are discussed. It is argued that shared rights and responsibilities for the Space Station between the U.S. and Europe are required for the Space Station development to be successful.

#### A87-37971

## MIR IN ACTION

Spaceflight (ISSN 0038-6340), vol. 29, April NEVILLE KIDGER 1987, p. 136, 137.

Soviet undertaken in the activities manned-space-station program in early 1987 are described and illustrated with photographs. Consideration is given to the launch of Progress 27 on January 16 and the components of its astrophysics payload module (the ESA Sirene-2 high-pressure gas-scintillation counter, a Netherlands experiment including the TTM coded-mask imaging spectrometer, a West German scintillation spectrometer for 15-250-keV X-ray sources, and the Soviet Pulsar X-1 sensor for X and gamma rays up to 800 keV). Also discussed are the preparation and launch (on February 5) of Soyuz TM-2 with two cosmonauts aboard, Soyuz-Mir docking on February 8, orbit adjustments on February 11 (using the Progress engines), the apparent failure of the Luch GEO relay spacecraft, and plans for a visit to Mir by three cosmonauts in July 1987. T.K.

### A87-38443

## THE SIGNE II GAMMA-RAY BURST EXPERIMENT ABOARD THE PROGNOZ 9 SATELLITE

M. BOER, K. HURLEY, M. NIEL, G. VEDRENNE (Centre d'Etude Spatiale des Rayonnements, Toulouse, France), A. KUZNETSOV (AN SSSR, Institut Kosmicheskikh Issledovanii, Moscow, USSR) (COSPAR, Plenary Meeting, 26th, Topical Meeting on Gamma-Ray Astronomy, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 4, 1986, p. 97-102. refs

The Signe II M p-9 experiment operated aboard the Prognoz 9 satellite for 8 months in 1983-1984. It was designed to study cosmic and solar gamma ray bursts in the 40-8000 keV energy range, using two 178 sq cm Nal scintillators. A description of the mission and the experiment are presented. The experiment discovered what appears to be a unique new transient source, and has also provided evidence for rapid spectral variability at Author MeV energies in a gamma burst spectrum.

#### A87-38727

## SYSTEM ASPECTS OF COLUMBUS THERMAL CONTROL

U. LAUX, K. BECKMANN, and R. LAWSON (MBB-ERNO Raumfahrttechnik GmbH, Bremen, West Germany) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986 . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 247-257.

(SAE PAPER 860938)

The Columbus spacecraft's thermal control system must cope with numerous different mission phases, including Space Shuttle transportation to orbit, in-orbit assembly, payload operation, payload servicing, payload dormancy, and even contingency operations that have yet to be defined in detail. Attention is presently given to a thermal control system design approach that stresses encompassing commonality at all levels for fluid types and their flow regimes, as well as for a pressurized module cooling loop design. These thermal control system determinations are then applied to Orbit Replaceable Unit design configurations.

#### A87-38728

### INFRARED TEST TECHNIQUE VALIDATION ON THE **OLYMPUS SATELLITE**

P. MESSIDORO and E. COLIZZI (Aeritalia S.p.A., Turin, Italy) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986 . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 259-268. refs (SAE PAPER 860939)

The sheer size of the Columbus spacecraft and the presence of heat pipes on both of its radiators have suggested the present use of a spacecraft thermal model to assess the feasibility of IR testing. Data have been thus obtained which are pertinent to thermal control system design and both thermal and mathematical modelling. Attention is given to the test apparatus employed, the power control system used, and the characteristics of such IR test elements as IR sources, flux requirement definitions, outer surface property measurements, and the correlation methods applied to the test results.

#### A87-38747

### PHYSIOLOGICAL REQUIREMENTS AND PRESSURE CONTROL OF A SPACEPLANE

LOUIS LEMAIGNEN, CATHERINE FAGOT, and MARC WEIBEL (Avions Marcel Dassault Breguet Aviation, Saint-Cloud, France) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986 . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 475-484. refs (SAE PAPER 860965)

After a short presentation of the different functions of the Environmental Control and Life Support System (ECLSS), the paper shows the driving role of the atmosphere delivery and pressure control subsystem. The main physiological requirements of environmental control are presented: oxygen delivery, total pressure and total pressure variations, carbon dioxide concentration. The acceptable limits of the different parameters are discussed and a comparison is made with the operational requirements of existing space vehicles. From this analysis a selection is made for nominal, degraded and emergency modes. A safety philosophy is presented and application is made to different emergency situations. For emergency situations, the proposed solution is intermediate between the Orbiter choice and the Soyuz approach. A mathematical model of the vehicle's partial pressures is presented. This computer program is used to optimize the pressure management in the emergency modes and in transient conditions like EVA prebreathing and airlock operation.

#### A87-38748

### COLUMBUS LIFE SUPPORT SYSTEM AND ITS TECHNOLOGY **DEVELOPMENT**

H. P. LEISEIFER, A. I. SKOOG, and H. PREISS (Dornier System IN: Aerospace GmbH. Friedrichshafen, West Germany) environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986 . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 485-497. ESA-BMFT-supported research. refs (SAE PAPER 860966)

The ESA's Columbus program element of the NASA Space Station employs a Pressurized Module (PM) whose Environmental Control and Life Support Subsystem (ECLSS) baseline is presently discussed for the case of PM attachment to the Space Station

and in view of comparisons with the Spacelab ECLSS. A systems approach is used in these considerations, and technology readiness and development requirements are identified in light of hardware-related **ECLSS** design factors. Technology implementation goals are then formulated. The PM ECLSS undertakes atmospheric pressure and composition control, CO2 management, atmospheric contamination management, cabin temperature and humidity management, avionics and experiment cooling, fire detection and suppression, water and waste management, and power and thermal budgeting.

#### A87-39594#

EUROPE PREPARES FOR MANNED ORBITED OPERATIONS RUDI G. REICHERT Dornier Post (English Edition) (ISSN 0012-5563), no. 1, 1987, p. 44-47.

Manned space operations proposed by ESA are discussed. The development of a space suit system is examined in terms of its applications and life support system requirements. Consideration is given to the fabrication of manned maneuvering equipment and special test facilities for evaluating new equipment, and an air lock design.

#### A87-39836

## NON-INTRUSIVE TECHNIQUES FOR THERMAL MEASUREMENTS IN MICROGRAVITY FLUID SCIENCE

R. MONTI and R. FORTEZZA (Napoli, Universita, Naples, Italy) (COSPAR, Plenary Meeting, 26th, Topical Meeting on Material Sciences in Space - IV, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 5, 1986, p. 69-80. Research supported by Montedel-Montecatini Edison Elettronica S.p.A.

Three nonintrusive techniques for thermal measurements in microgravity fluid dynamics are considered in the paper: liquid crystals tracers, thermographic system, and thin-foil fluxmeter. Liquid crystals have been employed both as tracers (for the evaluation of the flow field organization) and as point thermometers (for the temperature distribution). Liquid surface measurements are performed in closed and open cells. Heat fluxes measurements have been performed by thin-foil fluxmeters, and temperature by thermographic method. The laboratory experimentation substantiate the applicability of these techniques in fluid dynamics experimentation on space platforms. Author

#### A87-40339

## LEGAL PROBLEMS CONCERNING MANNED SPACE FLIGHT [PRAVOVYE PROBLEMY POLETOV CHELOVEKA V KOSMOS]

E. G. VASILEVSKAIA, V. S. VERESHCHETIN, G. P. ZHUKOV, E. P. KAMENETSKAIA, and A. I. RUDEV Moscow, Izdatel'stvo Nauka, 1986, 224 p. In Russian. refs

A systematic analysis of legal problems concerning manned space flight is presented. Issues addressed include the legal sense of the concepts of manned spacecraft, astronaut, and spacecrew; jurisdiction over manned spacecraft and spacecrews; the law governing manned orbital stations; legal problems concerning human activity on the moon, international spacecrews; and legal aspects of crew safety. Consideration is also given to responsibility for human activity in space in the context of international law, the legal consequences of the privatization of space activity, and the prevention of space militarization.

#### A87-40342

### K.E. TSIOLKOVSKII AND PROBLEMS IN THE DEVELOPMENT OF SCIENCE AND TECHNOLOGY [K.E. TSIOLKOVSKII I PROBLEMY RAZVITIIA NAUKI I TEKHNIKI]

B. M. KEDROV, ED. and A. A. KOSMODEM'IANSKII, ED. Moscow, Izdatel'stvo Nauka, 1986, 192 p. In Russian. No individual items are abstracted in this volume.

Aspects of long-duration space flight are examined in the light of Tsiolkovskii's ideas. Particular consideration is given to advances in rocket and space technology, space-flight mechanics, and space industrialization. A number of biomedical problems connected with

the prolonged stay of man in space are examined. Philosophical problems connected with space exploration are discussed along with Tsiolkovsii's theories about scientific prediction.

### A87-40513#

### THE SPACE STATION - USES AND USERS [DIE RAUMSTATION - NUTZEN UND NUTZER]

DIETRICH LEMKE (Max-Planck-Institut fuer Heidelberg, West Germany) Sterne und Weltra 0039-1263), vol. 26, April 1987, p. 202-205. In German. Sterne und Weltraum (ISSN

The status of the Space Station (SS) program three years after its inception is reviewed from a European perspective, with emphasis on astronomy applications. Topics discussed include the ESA Columbus contribution to the SS (manned laboratory module, free-flying unmanned laboratory, polar platform, and Eureca multipurpose vehicle); the basic scientific research (with limited immediate economic return) to be undertaken; vibration problems for telescopes mounted on the main SS structure; the value of manned laboratories; the technological, political, and economic lessons of the Spacelab program for ESA; and proposals to increase European space independence. Concern is expressed that potential scientific SS users may have difficulty in obtaining funding and/or Spacelab prototype-testing opportunities for their experiments, due to the cost of the SS itself and the U.S. military, commercial, and SS-related demands on Shuttle space when flights resume.

#### A87-41219

## THOUGHTS ON EUROPE'S FUTURE IN SPACE

HARRY O. RUPPE (Muenchen, Technische Universitaet, Munich, West Germany) Space Policy (ISSN 0265-9646), vol. 3, May 1987, p. 89-91.

ESA plans for the near term are reviewed from a technological perspective, with an emphasis on the Ariane 5, Hermes, and Columbus programs, and a number of specific criticisms and recommendations are presented. The development of Ariane 5L as a possible successor to the Ariane 5P, continuation of some versions of Ariane 4 for smaller single payloads, postponement of the current Hermes in favor of a simple space capsule, and more intensive study of transport from the Space Station to application orbits (such as polar orbits) are recommended. Current proposals for launch vehicles with air-breathing initial stages (Hotol, Saenger, TAV, etc.) are viewed with scepticism, pointing to a lack of adequate data on the performance, development schedules, critical technologies, costs, and facilities requirements of such vehicles.

### A87-41429 COLUMBUS/SPACE STATION UNITED KINGDOM UTILISATION STUDY 1985/6 REPORT - EXECUTIVE

International Journal of Remote Sensing (ISSN 0143-1161), vol. 8, April 1987, p. 545-554.

The opportunities that participation in the Space Station and Columbus programs would provide for the user communities of the United Kingdom are examined. Strategies for participating in these programs and obtaining benefits are proposed. The conditions under which the United Kingdom would participate in the Columbus program are described. It is recommended that the UK be involved in the development of the Polar Platform, the space segment of the Columbus infrastructure, advanced sensor payloads, a national ground segment, R&D, and the establishment of a strong user community. Consideration is given to the education and training of people in space technology, and the financing of the project. It is noted that participation in the Columbus program will benefit operational activities such as meteorological and oceanographic forecasting, a wide range of commercial operations, and research in many areas such as earth science and astrophysics.

#### A87-41570

JAPANESE EXPERIMENT MODULE (JEM) PRELIMINARY **DESIGN STATUS** 

M. SAITO, K. HIGUCHI, and K. SHIRAKI (National Space Development Agency of Japan, Tokyo) (IAF, International Astronautical Congress on Space: New Opportunities for all People, (IAF, International 37th, Innsbruck, Austria, Oct. 4-11, 1986) Acta Astronautica (ISSN 0094-5765), vol. 16, 1987, p. 47-53.

The first half of the present two-year study of the Japanese Experiment Module's (JEM) preliminary design has given attention to the definition of basic design requirements, major interface areas between JEM and the NASA Space Station core, and such general issues as the JEM configuration, basic development plan, and operations. The second half of the study will evaluate the technology development requirements of JEM elements' preliminary design, as well as engage in the preparation of schedules and requirements for the next two development stages.

SPACE STATION OPPORTUNITY FOR UK IN EARTH SENSING JOHN PLEVIN and DAVID LYNN (NERC, Swindon, England) Spaceflight (ISSN 0038-6340), vol. 29, May 1987, p. 193-197.

A national UK program aimed at developing a polar platform preparatory program, a national sensor development program, data management facilities, and arrangements for operation and management of the polar platform in space is proposed. The need for a polar platform preparatory program in order to develop applications for the platform and to educate and train the users is discussed; the goals of this program are described. The role of the polar platform in remote sensing is examined. Consideration is given to the designing of the polar platform to meet user requirements, and the benefits the platform will provide to earth observation studies by industry, government, and science.

#### EFFECT OF CREW MOTIONS ON THE SPATIAL POSITION OF A SPACECRAFT [O VLIIANII DVIZHENIIA KOSMONAVTA NA PROSTRANSTVENNOE POLOZHENIE KOSMICHESKOGO KORABLIA]

Akademiia Nauk SSSR, Izvestiia, Mekhanika G. R. SALIMOV Tverdogo Tela (ISSN 0572-3299), Mar.-Apr. 1987, p. 20-26. In Russian. refs

Equations of motion for a spacecraft are obtained with allowance for the motions of the crew inside the spacecraft and on its outside surface. The spacecraft is modeled by a rigid body and the crew by a point mass; the motion of the crew is assumed to be known a priori. In particular cases, an analysis is made of the relationship between the angular velocity and system parameters. It is shown that when the crew moves at a constant relative velocity, the angular velocity of the spacecraft depends only on the final position of the crew. A class of possible trajectories is examined, and results of numerical calculations are presented.

A87-42266#

MODAL-SURVEY TESTING OF THE OLYMPUS SPACECRAFT R. STEELS and D. BASTON (ESA, Communications Satellite Dept., Noordwijk, Netherlands) ESA Journal (ISSN 0379-2285), vol. 10, no. 4, 1986, p. 363-371.

This paper describes the background to the introduction of a spacecraft modal-survey test into the development program for ESA's Olympus telecommunications satellite. It details the objectives of such tests, how the test was actually performed, and the use to which the test results have been put. A concluding section assesses the benefits that have accrued to the Olympus satellite program from the tests performed. Author

A87-42923

#### THE GAGARIN SCIENTIFIC LECTURES IN ASTRONAUTICS AND AVIATION. 1985 [GAGARINSKIE NAUCHNYE CHTENIIA PO KOSMONAVTIKE I AVIATSII. 1985 G.]

A. IU. ISHLINSKII Moscow, Izdatel'stvo Nauka, 1986, 240 p. In Russian. No individual items are abstracted in this volume.

Several of the presentations from the Gagarin lectures are presented in full, including reports on 25 years of activity at the Gagarin Cosmonaut Training Center, preliminary results from the 237-day mission on Salyut-7, and the Vega mission to Comet Halley. Finally, abstracts are presented for a large number of papers from various fields, including flight mechanics, flight simulation, spacecraft design, space manufacturing, and thermal and gasdynamic problems of space flight.

#### A87-43156

### JAPAN'S SPACE DEVELOPMENT PROGRAMS FOR **COMMUNICATIONS - AN OVERVIEW**

TADAHISA MORI and TAKASHI IIDA (Ministry of Posts and Telecommunications, Tokyo, Japan) IEEE Journal on Selected Areas in Communications (ISSN 0733-8716), vol. SAC-5, May 1987, p. 624-629. refs

Japan now operates the communications satellite CS-2. A test communications satellite, CS-1, was launched in 1977, and CS-3 will be launched in 1988 as a successor to CS-2. In the area of mobile satellite communications development, Japan is proceeding with an experimental program, ETS-V/EMSS (Engineering Test Satellite-V/Experimental Mobile Satellite System), for which a satellite will be launched in 1987. A follow-up experimental ETS-VI program is planned and will be launched in 1992 as a 2000-kg weight class satellite. Japan has also begun an Experimental Platform Study as a step toward the Geostationary Communication Platform. This paper reviews and explains the scenario, activities, and objectives of satellite communications development in Japan.

### SOLAR POWER SATELLITES [SOLNECHNYE KOSMICHESKIE **ENERGOSTANTSII**]

VLADIMIR ALEKSANDROV GRILIKHES Leningrad, Izdatel'stvo Nauka, 1986, 182 p. In Russian. refs

The current status of research on the solar power satellite (SPS) concept is reviewed. Particular consideration is given to the development of microwave power transmission systems and to alternative SPS designs (thermal and photoelectric). Problems connected with the development of SPS systems are considered; these include problems of construction and transportation as well as ecological, social, and economic problems.

#### A87-45257#

## ARIANE TRANSFER VEHICLE (ATV) TO SUPPLY SPACE

R. RAULT (Aerospatiale, Les Mureaux, France) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 23rd, San Diego, CA, June 29-July 2, 1987. 9 p. (AIAA PAPÉR 87-1862)

Ariane transfer vehicle mission description is described as well as ATV design, the propulsion subsystem (and others), performance, and development plan and cost assessment. Particular attention is given to the major results of a comprehensive study performed for the ESA within the Columbus studies program. It is noted that, as a fully autonomous system, ATV is not limited to use on Ariane 5.

#### A87-46121

DETERMINATION OF THE NATURAL FREQUENCIES OF THE LONGITUDINAL AND TORSIONAL VIBRATIONS OF TRUSS STRUCTURES WITH ATTACHED RIGID BODIES [OB OPREDELENII SOBSTVENNYKH CHASTOT PRODOL'NYKH I KRUTIL'NYKH KOLEBANII FERMENNYKH KONSTRUKTSII S PRISOEDINENNYMI TVERDYMI TELAMI]

S. V. KOZLOV and N. I. VOITKOV (AN USSR, Institut Mekhaniki, Kiev, Ukrainian SSR) Prikladnaia Mekhanika (ISSN 0032-8243), vol. 23, May 1987, p. 95-102. In Russian. refs

A method is presented for determining the effective elastic and inertial characteristics of a continuum idealized model of large truss structures with allowance for rigid connections between the rod elements. The method is applied to the analysis of the longitudinal and torsional vibrations of a truss structure consisting of beam members with attached massive bodies at the ends. Changes in the natural vibration frequencies of the structure are determined as a function of the attached masses.

#### A87-46872#

#### MIR - A SECOND SPUTNIK?

RICHARD DEMEIS Aerospace America (ISSN 0740-722X), vol. 25, July 1987, p. 24-27.

The efforts of the Soviets on the development of a large permanent space station complex for the 1990's are considered. The Mir space station has a transfer module with four side berthing ports to accommodate the Kosmos lab modules used for astrophysics, earth resource, material processing, and biology research; solar panels that provide 9-10 kW of electric power; an antenna that increases the time of contact with the flight control center; eight on-board computers; and improved living conditions. The transfer of the Mir crew to Salyut 7, and some of the experiments conducted on Salyut 7 and Mir are described. The need to establish a definite space policy in order for the U.S. to develop a Space Station is discussed.

#### A87-46945

## **COLUMBUS PRESSURIZED MODULES**

ERNESTO VALLERANI (Aeritalia S.p.A., Settore Spazio, Turin, Italy) Space (ISSN 0267-954X), vol. 3, May-June 1987, p. 10-12, 14, 15.

14, 15.

The present status and prospects for the Columbus program are reviewed. The two modules of the Columbus program, the Pressurized Module and the Man-Tended Free Flyer, are discussed, including present design plans and operational issues. The primary structures of the modules and the environmental control and life support, thermal control system, electrical power distribution system, communications, and data management system for the modules are reviewed. The U.S. Defense Department's interest in the Space Station and its effects on the Columbus program are considered.

#### A87-47302

#### THE SOVIET SPACE SHUTTLE PROGRAMME

TONY LAWTON Spaceflight (ISSN 0038-6340), vol. 29, July 1987, p. 4-7.

The launch vehicles and hypersonic spaceplanes being developed by the Soviet Union are examined. Consideration is given to the Proton launch vehicle that has a lifting capability of 19.5 tons to LEO; the SL-X-16, a medium-lift launch vehicle with a payload capability of 15 tons; the SL-W shuttle; the SL-W heavy-lift launch vehicle; and the spaceplane, Kosmolyot I and II. The flight testing of the midgelike hypersonic aircraft, referred to as Moshka, and a large spaceplane, Buran, which has the main engines located on the frame carrying the fuel tanks and boosters, are discussed. It is suggested that the space shuttle may be added to the Salyut and Mir in order to create a large space station complex. The first launch of the heavy lift launcher, Energia, is also discussed. Diagrams of the launch vehicles, Moshka, Buran shuttle, and a possible advanced space station configuration are presented.

#### A87-48157

# THE PROBLEM OF RADIATION EXPOSURE IN THE SPACE STATION (DAS PROBLEM DER STRAHLENBELASTUNG IN DER RAUMSTATION)

H. BUECKER and G. REITZ (DFVLR, Institut fuer Flugmedizin, Cologne, West Germany) IN: Yearbook 1986 II; DGLR, Annual Meeting, Munich, West Germany, Oct. 8-10, 1986, Reports . Bonn, Deutsche Gesellschaft fuer Luft- und Raumfahrt, 1986, p. 504-512. In German. refs

(DGLR PAPER 86-175)

The radiation environment at the Space Station orbit is characterized, summarizing data obtained on Spacelab D1 and other earlier missions, and its implications for the design and use of the Space Station are considered. Consideration is given to the principal radiation sources (solar-wind and solar-flare protons, auroral protons and electrons, trapped protons and electrons, and Galactic cosmic rays); the frequency of South Atlantic Anomaly (SAA) crossings by the Space Station; the relative biological effectiveness of the different radiation types; linear-effective-transit spectra for space missions since Apollo 16; and D1 Biorack results.

It is estimated that the 50-rem maximum annual dose recommended by the National Committee of Radiation Protection (1975) would be reached after 172 days on the Space Station, even if the SAA uncertainties, the effects of microgravity on radiation sensitivity, and solar flares are not taken into account.

#### A87-48578#

#### **ESA'S FUTURE INTEGRATED SPACE DATA SYSTEM**

CLAUDE HONVAULT (ESA, European Space Operations Centre, Darmstadt, West Germany) AIAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 9 p. (AIAA PAPER 87-2190)

The approach taken by the ESA to meet the challenge of the space data systems of the next decade is described. Objectives for the next 13 years include participation in cooperative programs as partners in the Space Station program and eventual European independence of the in-orbit infrastructure. The achievement of these objectives requires the establishment of standards for electronic data exchange and processing and the implementation of an integrated system design approach for the ground facilities. The proposed space data system consists of a data relay satellite system concept based on a decentralized system whereby the downlink channels can be directly accessed by user terminals in the broadcast area and the uplinkings authorized by a traffic management center. An overview is given of the present-day communications requirements of the Hermes spaceplane. K.K.

#### A87-48579#

#### JAPANESE SPACE INFORMATION SYSTEM OVERVIEW

K. MATSUMOTO (National Space Development Agency of Japan, Tokyo) AlAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 8 p. (AIAA PAPER 87-2191)

The space operations and data system (SODS) which will provide operational capabilities for the H-II rocket and space shuttle era is proposed. The SODS is to consist of a global communications network system, an operational control system, and an engineering support and information system. The capabilities of the SODS and the functions of its systems are described. The stages for the implementation of the system are discussed. Diagrams of the SODS are presented.

#### A87-48580#

## JAPANESE CUSTOMER NEEDS FOR SPACE STATION

K. HIGUCHI, I. IIZUKA, and Y. FUJIWARA (National Space Development Agency of Japan, Tokyo) AIAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 10 p. (AIAA PAPER 87-2193)

Results from mission analysis in communications, the requirements of Japanese customers, and the Japanese Experiment Module Information System (JEMIS) are discussed. Mission objectives include: scientific observation, earth observation, communications, materials processing and production, life science, and technology development. The data exchange between the Japanese Experiment Module (JEM) and the ground was analyzed; it is determined that experimental, computer voice, video, and real and nonreal time data are required for the communications missions. A cosmic gamma ray burst, space energy, and test of sensor technologies experiments will be conducted to define the capacity of data transmissions. The JEMIS will provide payload operation support functions and increase JEM operation while retaining operating flexibility. The main elements of the information system, its functions, and JEMIS data transmission requirements are described. Diagrams of the JEMIS are presented.

#### A87-48581#

# SCIENTIFIC USER REQUIREMENTS FOR MICROGRAVITY RESEARCH (EUROPEAN ASPECTS)

I. EGRY, G. OTTO, and B. FEURBACHER (DFVLR, Cologne, West Germany) AIAA and NASA, International Symposium on Space

Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 7 p. refs (AIAA PAPER 87-2195)

The user requirements on the Columbus elements and their implications regarding telescience are discussed. Telescience experience gained during the D1 mission (fall of 1985) is described. A graph is presented which reveals the dramatic increase in utilization potential that Columbus offers compared to Spacelab or Eureca flights. It is noted that a huge ground infrastructure involving interconnected mission control centers, user support centers, and user operation centers will be necessary to fully exploit this opportunity.

K.K.

#### A87-48585#

## JAPANESE DATA RELAY SATELLITE SYSTEM

M. IKEUCHI, T. TANAKA, M. KAJII, H. AWAZAWA, T. DOURA (National Space Development Agency of Japan, Tokyo) et al. AIAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 9

(AIAA PAPER 87-2199)

This paper describes one possible Japanese data relay satellite system concept for the Space Station era. The Data Relay and Tracking Satellite System (DRTSS) will provide S-band and Ka-band communication and tracking service for orbiting spacecraft with data rates up to 300 Mb/s. Mission objectives and analysis are discussed, and the related experimental ETS-VI program is also presented.

# A87-48592# ESA SOFTWARE ENGINEERING STANDARDS FOR FUTURE PROGRAMMES

C. MAZZA (ESA, European Space Operations Centre, Darmstadt, West Germany) AIAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 7 p. refs (AIAA PAPER 87-2207)

ESA has established since several years a board for software standardization which has developed and promoted the ESA Software Engineering Standards. These Standards have been in use now for 3 years on several software projects and subsequently reviewed. The last issue will constitute the baseline for software standards for all ESA future missions. The essential principles on which the standards are based are explained. ESA has also formulated a policy for the choice of programming languages for tuture projects and for the selection of a European Space Software Development Environment which will support the above standards and the selected languages.

#### A87-48595#

# ANALYSIS AND IMPLEMENTATION OF AUTOMATION ASPECTS IN THE COLUMBUS AND HERMES END TO END SYSTEMS

M. SAINZ (Matra, S.A., Toulouse, France) AIAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 6 p. (AIAA PAPER 87-2210)

A profile is presented of European space operations with emphasis placed on new space programs, space infrastructure, constraints (operational, user, and program), and automation. Lessons learned from the Spot 1 satellite and Spacelab are also discussed. The areas of automation on-board Columbus and Hermes are contingency, configuration, and operations management as well as crew interface. Ground-based automation candidates are contingency management, telecommand generation, payload operations planning, and interaction. K.K.

#### A87-48596#

# THE HARDWARE/SOFTWARE ARCHITECTURE OF THE COLUMBUS PRESSURIZED MODULE ELEMENT

G. C. CASSISA and L. SARLO (Aeritalia S.p.A., Gruppo Sistemi Spaziali, Turin, Italy) AIAA and NASA, International Symposium

on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 9 p. (AIAA PAPER 87-2211)

Pressurized module (PM) functions and services relevant to the Columbus Information Management System (CIMS) are considered. Included are system level management, man machine interface, data distribution, check-out, and servicing support. The CIMS hierarchical organization is described as well.

K.K.

## A87-48605#

# EVOLUTION OF DATA MANAGEMENT SYSTEMS FROM SPACELAB TO COLUMBUS

G. BRANDT and H. J. POSPIESZCZYK (MBB-Erno Raumfahrttechnik GmbH, Bremen, West Germany) AIAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 8 p. (AIAA PAPER 87-2227)

This paper describes the evolution of data management systems, starting with the generic Spacelab design and followed by its utilization during the missions FSLP, D1, and D-2 It describes the Eureca system and finally outlines the Columbus plans. It discusses the experience gained in particular from Spacelab development and mission preparation. An attempt is made to formulate the corresponding Columbus guidelines.

#### A87-49030

# RADIATION PROTECTION PROBLEMS FOR THE SPACE STATION AND APPROACHES TO THEIR MITIGATION

H. BUECKER and R. FACIUS (DFVLR, Institut fuer Flugmedizin, Cologne, West Germany) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 305-314. refs

This paper considers the radiation protection standards, the systems of dosimetric surveillance, and the possible methods of selective shielding for a space station. The problems that need to be investigated include the composition of the external radiation field and the variability in space and time in the conditions of the radiation field, the spacecraft shielding interaction, the effects of the depth-dose distribution, the unique HZE effects, the relative contribution of the separate radiation components to the total dose equivalent deposited in man's critical organs, and a possible contribution to radiation-effected damage by microgravity. The need of a radiation monitoring system and personnel dosimeters is emphasized.

#### A87-49967#

# LIFE SUPPORT SUBSYSTEM CONCEPTS FOR BOTANICAL EXPERIMENTS OF LONG DURATION

H. LOESER (MBB-ERNO Raumfahrttechnik GmbH, Bremen, West Germany) Intersociety Conference on Environmental Systems, 16th, San Diego, CA, July 14-16, 1986, Paper. 18 p. refs (MBB-UR-E-907-86-PUB)

The likely requirements (in terms of air temperature, relative humudity, composition of atmosphere, and fluids control) of the Life Support Subsystem (LSS) designed for orbital botanical facilities to be flown on Eureca and those of the Environmental Control and Life Support Subsystem (ECLSS) designed for the Columbus carrier are compared. It was found that, while many requirements for the LSS and ECLSS are identical or similar, two requirements (the desired CO2 partial pressure and relative humidity) are not. On the basis of these results, various LSS concepts are discussed which would interact to varying degrees with the ECLSS (in a sense that the ECLSS would be used as a resource for the consumables needed by the LSS). Consideration is given to the advantages and disadvantages of such interaction, in particular the weight savings and technical complexity.

#### A87-50792 SPACE STATION - ALL CHANGE?

CHRIS BULLOCH and JOHN RHEA Space Markets (ISSN 0258-4212), Autumn 1986, p. 164-167.

The status of the International Space Station is assessed from a European perspective. NASA's role in coordinating international cooperation is discussed. Particular attention is given to legal concerns.

#### A87-51870

# STRUCTURE AND DESIGN OF SPACECRAFT [KONSTRUKTSIIA | PROEKTIROVANIE KOSMICHESKIKH LETATEL'NYKH APPARATOV]

NIKOLAI IVANOVICH PANICHKIN, IURII VALENTINOVICH SLEPUSHKIN, VIACHESLAV PAVLOVICH SHINKIN, and NIKOLAI ALEKSANDROVI IATSYNIN Moscow, Izdatel'stvo Mashinostroenie, 1986, 344 p. In Russian. refs

The structure and the general principles of the design of spacecraft and launch vehicles are reviewed. In particular, attention is given to the fundamentals of the theory of jet propulsion and space flight mechanics, selection of the main design parameters of launch vehicles and spacecraft, design of manned spacecraft, and design of spacecraft powerplants. The discussion also covers the selection of structural materials, strength analysis of structural elements, and design of specific spacecraft systems and components.

#### A87-53117

# AN ADVANCED WIND SCATTEROMETER FOR THE COLUMBUS POLAR PLATFORM PAYLOAD

M. LANGEMANN and R. W. ZAHN (Dornier System GmbH, Friedrichshafen, West Germany) IN: IGARSS '87 - International Geoscience and Remote Sensing Symposium, Ann Arbor, MI, May 18-21, 1987, Digest. Volume 1 . New York, Institute of Electrical and Electronics Engineers, Inc., 1987, p. 175-178.

In 1986, ESA/ESTEC performed a study of a payload for the Columbus Polar Platform to be launched in 1995, which shall carry various earth observation instruments. One core instrument is the wind scatterometer, an upgraded version of the ERS-1 wind scatterometer. This paper will describe the instrument design in terms of instrument configuration, electrical design, and on-board data processing.

#### A87-53554#

#### MICROGRAVITY EXPERIMENTS ONBOARD EURECA [MICROZWAARTEKRACHT-ONDERZOEK AAN BOORD VAN EURECA]

D. FRIMOUT (ESA, European Space Research and Technology Centre, Noordwijk, Netherlands) Ruimtevaart, vol. 36, Apr.-June 1987, p. 20-36. In Dutch.

The design of Eureca and the profiles of planned missions are discussed, with an emphasis on reduced-gravity (RG) processing of materials. An overview of RG research is given, including ground RG facilities, the RG environment in LEO, the advantages of RG for material science experiments, and Spacelab-1 RG results. Eureca is a 4000-kg multipurpose platform with 1000-kg payload capacity and a 1-kW solar power system; it is designed for Shuttle or Hermes robot-arm release in LEO (300 km), self-propulsion to 525 km, unattended operation for 6 mo, automatic shutdown to a 'sleeping' state for 1-3 mo, return to 300 km, and retrieval for return to earth. The payload for the first flight (tentatively scheduled for 1991) includes a multifurnace assembly, an automatic mirror facility, a protein-crystallization facility, a solution-growth facility, and an exobiological and radiation facility. Diagrams, drawings, and photographs are provided.

#### A87-53558

# 'HEXE' - X-RAY OBSERVATORY IN SPACE ['HEXE' - ROENTGENOBSERVATORIUM IM WELTRAUM]

Astronautik (ISSN 0004-6221), vol. 24, Apr.-June 1987, p. 41, 42. In German.

An overview is given of the design concept and scientific goals of the High-Energy X-ray Experiment (HEXE), developed in the FRG (by the Max Planck Institute for Extraterrestrial Physics and the Astronomical Institute of Tuebingen University) for operation

on the Soviet space station Mir. HEXE was launched to LEO using a Kvant vehicle on March 31, 1987; after initial docking problems, it was joined to Mir by two cosmonauts in a 3-hour EVA on April 12. HEXE has dimensions 45 x 45 x 75 cm and weight 180 kg; it employs an 800-sq-cm Ti-doped Nal/Csl phoswich detector for 15-250-keV X-rays, complementing the other Mir instruments: the ESTEC high-pressure gas-scintillation proportional counter (3-100 keV), the Soviet high-energy detector (20-800 keV), and the Dutch-British X-ray camera (2-30 keV). The Mir observations are intended to explore the energy spectra and time evolution of compact galactic and extragalactic objects.

#### A87-53559

THE GDR AND THE SOVIET SPACE PROGRAM - THE OPTICAL INSTRUMENT SECTOR OF THE GDR CONTRIBUTIONS [DIE DDR UND DIE SOWJETISCHE RAUMFAHRT - OPTISCHE GERAETE DOMAENE DER DDR-BEITRAEGE]

KLAUS BURCZIK (Soldat und Technik, no. 2, 1987) Astronautik (ISSN 0004-6221), vol. 24, Apr.-June 1987, p. 43, 44. In German.

The role of the GDR optics and electronics industries in the development of instruments for Soviet spacecraft is discussed. The early importance of German rocket scientists and the participation of GDR cosmonauts are recalled; and individual series of instruments are briefly characterized, including ionic and gas concentration sensors, IR spectrometers for weather satellites, the BES-2 image-data receiver, demodulators for Intersputnik ground stations, the Luch transponders for GEO satellites, and smaller components for several series of experimental and remote-sensing satellites. Special consideration is given to the MKF-6 and MKF-6M multispectral cameras built for use on Salyut; drawings and photographs are provided.

#### A87-53560

# POWER PLANTS IN SPACE [KOSMISCHE KRAFTWERKE] SERGEI GRISHIN Astronautik (ISSN 0004-6221), vol. 24, Apr.-June 1987, p. 45, 46. In German.

Proposals for space conversion of solar energy to electric power for earth use are examined. The history of the basic concepts is traced, and the factors to be weighed when considering the construction and operation of such plants are indicated. For example, a system of 150 10-GW GEO power plants (required to meet global requirements for the year 2000) would require space installations of total mass 5-10 million tonnes (and hence orders of magnitude more propellants and semiconductors than the current or predicted world annual production, as well as significant pollution of the atmosphere by rocket launches). The possible use of lunar or asteroidal material to lower launch requirements is discussed, and it is pointed out that large-scale economic, social, political, and ecological problems must be solved before even the most modest proposals (for LEO power satellites) can be undertaken.

T.K.

#### A87-53916#

## FROM EURECA-A TO EURECA-B

R. MORY (ESA, Directorate of Space Station and Platforms, Paris, France) ESA Bulletin (ISSN 0376-4265), no. 50, May 1987, p. 24-31.

The design and capabilities of Eureca, a free-flying carrier of space payloads to be launched and retrieved by the Space Shuttle, are described. Eureca is 2.3 m long, weighs 4000 kg at launch, and is supported in the bay by two trunnions and a keel fitting. Consideration is given to the thermal-control system, electrical subsystem, data-handling subsystem, attitude and orbit control subsystem, and orbital transfer assembly of Eureca. The first Eureca-A mission is to consist of microgravity experiments (material and life science) that require long-duration space exposure. The growth capabilities of Eureca-A, and the development of a platform with improved in-orbit capabilities and designed for other space science experiments are discussed. Eureca-B, a three-axis stabilized, retrievable carrier with orbital transfer capabilities, has been developed; the upgraded capabilities that Eureca-B should provide are examined. I.F.

#### A87-53923#

#### THE COLUMBUS SYSTEM BASELINE AND INTERFACES

F. LONGHURST (ESA, Space Station and Platforms Directorate, Noordwijk, Netherlands) ESA Bulletin (ISSN 0376-4265), no. 50, May 1987, p. 88-97.

The initial and current system requirements, reference configurations, and reference operation concepts for the Columbus system are described. The initial baseline included a pressurized module, a resource module, free-flying unmanned platforms, and an unmanned service vehicle. Changes in the initial design of the Columbus system include: smaller configurations for the coorbiting and polar platforms; the use of a modified Eureca platform; the elimination of the service vehicle; new uses for the pressurized module; the introduction of a man-tended free-flyer (MTFF); the use of Ariane-5 to launch the polar platform and Hermes to service it; and the addition of the European data-relay satellite to the system's communication network. The current design for the Columbus system consists of a pressurized module, an MTFF, and polar and coorbiting platforms.

N87-20357# Messerschmitt-Boelkow-Blohm/Entwicklungspring Nord, Bremen (West Germany).

# RECENT DEVELOPMENTS AND FUTURE TRENDS IN STRUCTURAL DYNAMIC DESIGN VERIFICATION AND QUALIFICATION OF LARGE FLEXIBLE SPACECRAFT

E. HORNUNG, E. BREITBACH (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen, West Germany.), and H. OERY (Technische Univ., Aachen, West Germany.) In AGARD Mechanical Qualification of Large Flexible Spacecraft Structures 43 p Jul. 1986
Avail: NTIS HC A12/MF A01

A comprehensive dynamic verification concept is proposed, focusing on a multi-axis transient qualification test to be performed on the primary structure or on modular segments of it, respectively. First, practical experiences and development areas identified are addressed. Former existing barriers preventing the practical performance of this verification concepts are no longer relevant because of the extended analytical capabilities due to the positive developments in computer techniques and software and because of the availability of large multi-axis vibration simulators. A vital prerequisite for the applicability of this verification concept is the ability for analytical flightload identification and identification of the true dynamic characteristics on a high quality and reliability level. For this a comparative discussion is presented about the suitability of analytical methods for flightload predictions (shock spectra versus transient methods). The state of the art of design identification tests and of updating methods on mathematical models is summarized and discussed with respect to necessary development areas and the implementation into the proposed structure verification concept. First experience with this new verification cycle was made on a real satellite structure. The results and open development areas identified are discussed. Author

N87-20623# European Space Agency, Paris (France). Directorate of Space Station and Platforms.

### THE COLUMBUS PROGRAM: AN OVERVIEW

D. J. SHAPLAND *In its* Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-sensing (ESPOIR) p 11-17 Nov. 1986

Avail: NTIS HC A07/MF A01

The origins and content of the Columbus program are reviewed. The candidate elements to be studied in phase B2 are described: a pressurized module/laboratory permanently attached to the Space Station core; a man-tended free flyer (pressurized module plus resource module); a polar platform; and a co-orbiting platform based on Eureca technology and experience. A scenario and schedule of events is suggested and discussed in the framework of a total European plan. The importance of user requirements is stressed.

N87-20624# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). EUROPEAN UTILIZATION ASPECTS STUDIES F. SCHLUDE In ESA Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-sensing (ESPOIR) p 21-27 Nov. 1986

Avail: NTIS HC A07/MF A01

Starting from a synthesis of space station user data needs, a minimum instrumentation scenario was derived. Grouping of these instruments gave application oriented missions which led to two model missions that can be realized on an international two polar platform system.

N87-20626# Centre National d'Etudes Spatiales, Toulouse (France). SPOT IMAGE.

# REMOTE SENSING APPLICATIONS: COMMERCIAL ISSUES AND OPPORTUNITIES FOR SPACE STATION

G. BRACHET In ESA Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-sensing (ESPOIR) p 35-37 Nov. 1986

Avail: NTIS HC A07/MF A01

The SPOT program is reviewed and the long term prospects beyond SPOT-4 are assessed. Management, legal, and commercial aspects are emphasized.

N87-20627# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

### **ESA COLUMBUS POLAR PLATFORM DESIGN CONCEPT**

P. WOLF *In its* Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-sensing (ESPOIR) p 39-42 Nov. 1986
Avail: NTIS HC A07/MF A01

The Columbus polar platform (PPF) system requirements, configuration, payload complement model, subsystem concepts, and operational aspects are discussed. The PPF is intended to be a large general purpose spacecraft supporting scientific and operational users in a high inclination Earth orbit. Earth observations represent a large percentage of the potential user community, whose requirements essentially determine the design and performance of the PPF. The PPF design is planned to be relatively classical and conservative except for technology for an on-orbit servicing, maintenance, and upgrading capability to extend the life of this large vehicle, and in particular repair, upgrade, and modernize in-orbit the user instruments on board of the PPF, and to bring new instruments up to the PPF at determined intervals after the launch of the spacecraft and its initial payload complement.

N87-20629# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

#### **ORBIT CONFIGURATIONS**

N. DEVILLIERS In its Proceedings of the European Symposium Polar platform Opportunities and Instrumentation for Remote-sensing (ESPOIR) p 49-53 Nov. 1986

Avail: NTIS HC A07/MF A01

The International Space Station polar platform orbit is discussed. The effect of orbit class, number of orbits, nodal equatorial crossing times, altitude, repeat cycles (linked to altitude), relative phasing of platforms (linked to repeat cycles), and additional platforms are considered. A pair of platforms in Sun synchronous orbit, one in a morning orbit, the other an afternoon is proposed.

## N87-20635# Meteorological Office, Bracknell (England). OCEAN-ICE PANEL REPORT

T. D. ALLAN and A. MOREL *In* ESA Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-sensing (ESPOIR) p 85-88 Nov. 1986 Avail: NTIS HC A07/MF A01

Ocean/ice objectives, payload, observation strategy, and data management of Columbus are outlined. Ocean/ice objectives for Columbus should provide continuity to routine remote sensing of the global oceans and ice caps, and over European coastal zones; prepare for an operational system following the experimental and/or pre-operational satellite systems planned to be launched over the

next 5yr; develop and test techniques and concepts; provide improved scientific, social and economic benefits; and foster international, interagency cooperative programs aimed at the routine monitoring of the environment.

N87-20636# Belgian Royal Observatory, Brussels. SOLID EARTH PANEL REPORT

P. PAQUET In ESA Proceedings of the European Symposium

on Polar platform Opportunities and Instrumentation for Remote-sensing (ESPOIR) p 89-91 Nov. 1986

Avail: NTIS HC A07/MF A01

Investigations of geokinematics, Earth gravity, and geomagnetism by Columbus polar platforms are discussed. Candidate techniques for solid Earth missions, and support from solid Earth studies for Earth observations are considered. ESA

# N87-20638# European Space Agency, Paris (France). PANEL REPORT ON NEW APPROACHES TO CALIBRATION AND VALIDATION

S. BRUZZI *In its* Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-sensing (ESPOIR) p 99-100 Nov. 1986

Avail: NTIS HC A07/MF A01

The impact of the Columbus polar platform system on calibration and validation; the impact of availability of the space station system (including a coorbiting platform), and the impact of servicing were discussed.

N87-20640# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

#### THE ORBIT CONFIGURATION PANEL REPORT

D. DEVILLIERS *In its* Proceedings of the European Symposium on Polar platform Opportunities and Instrumenation for Remote-sensing (ESPOIR) p 103-106 Nov. 1986

Avail: NTIS HC A07/MF A01

The effects on Columbus polar platforms of class of orbits, number of orbits/platforms, nodal crossing times, orbit altitudes, repeat cycles, impact of an additional platform, and impact of having two half-sized platforms in each orbit are reviewed. The impact on meteorological sounders of reducing the altitude; possible choices of repeat cycles and the extent to which compromises can be found because of the conflicts with altitude; and a four-platform scenario, concentrating on the improvements possible in repeat cycles and the altitude choices available should be investigated.

# N87-20732# Joint Publications Research Service, Arlington, Va. SPACE BIOLOGY AND MEDICINE ON THE TWENTY-FIFTH ANNIVERSARY OF THE FIRST SPACEFLIGHT OF YURIY ALEKSEYEVICH GAGARIN

O. G. GAZENKO, N. N. GUROVSKIY, and A. A. GYURDZHIAN In its USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 3, May - Jun. 1986 (JPRS-USB-86-005) p 1-11 15 Aug. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 3, May Jun. 1986 p 4-12

Avail: NTIS HC A08/MF A01

Soviet Space exploration has come a long way in the quarter century that has elapsed after the historical day of the flight of Yu. A. Gagarin on 12 April 1961. The first flight, which lasted only 108 min, was to determine human capacities under conditions prevailing in space. As of 1 January 1986, Soviet cosmonauts had made 109 manned flights involving 60 people. Some of the participants had been in space 2 to 3 and even 5 times (V. A. Dzhanibekov). The Salyut orbital stations became a permanent space research laboratory. The crew consisting of L. D. Kizim, V. A. Solovyev and O. Yu. Atkov worked in space for 237 days. V. A. Dzhanibekov and V. P. Savinykh were able to find and dock with the inactive Salyut-7 station in space, repair it and completely restore its work capacity. In the 25 years that have passed since the first flight, space science has become a solid part of life, an inseparable element of the scientific, economic and sociocultural

life of mankind. The file of organizations that are planning spaceflights is full of applications for investigations in the interests of the most diverse scientific disciplines and the national economy.

Author

# N87-20735# Joint Publications Research Service, Arlington, Va. EVALUATION OF PHYSICAL WORK CAPACITY OF COSMONAUTS ABOARD SALYUT-6 STATION

V. A. TISHLER, A. V. YEREMIN, V. I. STEPANTSOV, and I. I. FUNTOVA In its USSR Report: Space Biology and Aerospace Medicine, Vol. 20, No. 3, May - Jun. 1986 (JPRS-USB-86-005) p 39-45 15 Aug. 1986 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 20, no. 3, May Jun. 1986 p 31-35 Avail: NTIS HC A08/MF A01

Electrocardiograms of Salyut-6 prime crewmembers recorded during their exercises on a bicycle ergometer and treadmill are presented. ECG were recorded by a portable tape recorder Cardiocassette and transmitted to the Earth via the radiocommunication channel. This procedure helped to better understand cardiovascular adaptation to different workloads, including submaximal, as well as reserve abilities of the body at various flight stages. This can be used advantageously to correct and control the training process as well as to predict the cardiovascular status at the final flight stage.

Author

# N87-21979# Joint Publications Research Service, Arlington, Va. PLANS FOR INDUSTRIALIZATION OF SPACE DISCUSSED

V. S. AVDUYEVSKIY *In its* USSR Report: Space (JPRS-USP-87-001) p 165-174 19 Feb. 1987 Transl. into ENGLISH from Zemlya i Vselennaya (Mowcow, USSR), no. 2, Mar. - Apr. 1986 p 2-9

Avail: NTIS HC A11/MF A01

The report by M. S. Borbachev, General Secretary of the CPSU Central Committee, on November 27, 1985, to the session of the USSR Supreme Soviet mentioned a comprehensive program for peaceful collaboration in space and the prospects for the industrial exploitation of space in the interests of all humanity. This program is a peaceful alternative to the misanthropic plans for the militarization of space. It includes the conducting of basic research in space, the creation of global systems of communications satellites, the study of the climate and the environmnet, the development of the science of space materials and medicine, and the creation of new space technology, including orbital scientific stations and manned spacecraft. What can such a program give to humanity if it is realized in the course of the next 25 years of the space era? The answer to this question is considered.

Author

# N87-21996\*# California State Univ., Northridge. SOVIET SPACE STATIONS AS ANALOGS, SECOND EDITION B. J. BLUTH and MARTHA HELPPIE Aug. 1986 576 p (Contract NAGW-659)

(NASA-CR-180920; NAS 1.26:180920) Avail: NTIS HC A25/MF A01 CSCL 22B

The available literature that discusses the various aspects of the Soviet Salyut 6 and Salyut 7 space staions are examined as related to human productivity. The methodology for this analog was a search of unclassified literature. Additional information was obtained in interviews with the cosmonauts and some Soviet space personnel. Topics include: general layout and design of the spacecraft system; cosmonauts role in maintenance and repair; general layout and design of the Mir complex; effects of the environment on personnel; information and computer systems; organization systems; personality systems; and physical conditin of the cosmonaut.

N87-25031# Consiglio Nazionale delle Ricerche, Rome (Italy). Piano Spaziale Nazionale.

#### THE COLUMBUS PROGRAM

ALBERTO LORIA In ESA Proceedings of the GIREP Conference 1986. Cosmos: An Educational Challenge p 31-36 Nov. 1986 Avail: NTIS HC A20/MF A01

#### **18 INTERNATIONAL**

The Columbus permanently manned space station project is outlined. In its first stage Columbus will have tight links with the International Space Station, the assembly of which is planned to start in 1993. Columbus should then develop into an autonomous European space station. The flight elements under negotiation with NASA with necessary ground infrastructures are described. Plans for the utilization of the system are summarized.

N87-25340# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Apparate.

BOTANICAL PAYLOADS FOR PLATFORMS AND SPACE STATIONS (BOTANISCHE NUTZLASTEN FUER PLATTFORMEN UND RAUMSTATIONEN)

HELMUT R. LOESER 1986 10 p In GERMAN Presented at the 35th Hermann-Oberth-Gesellschaft (HOG) e.V. Raumfahrtkongress, Garmisch-Partenkirchen, West Germany, 2-4 Oct. 1986 (MBB-UR-E-921/86; ETN-87-99954) Avail: Issuing Activity

The development of botanical orbital experiments for space platforms (EURECA) and space stations (Columbus) is presented. The scientific purposes of botanical payloads are outlined. The technological challenges for engineering brought about by such payloads are discussed. Two payloads in the engineering phase, the botany facility for the second EURECA mission, and the gravitational biology facility for the experiments module of Columbus, are presented, as well as their life support systems; the requirements and the solution concepts are discussed. ESA

N87-25418# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Apparate.
POSSIBILITIES OF THE FURTHER DEVELOPMENT OF COLUMBUS TO AN AUTONOMOUS EUROPEAN SPACE STATION [MOEGLICHKEITEN DER WEITERENTWICKLUNG VON COLUMBUS ZU EINER AUTONOMEN EUROPAEISCHEN RAUMSTATION]

W. WIENSS 1986 22 p In GERMAN Presented at the 35th Hermann-Oberth-Gesellschaft (HOG) e.V. Raumfahrtkongress, Garmisch-Partenkirchen, West Germany, 2-4 Oct. 1986 (MBB-UR-E-922/86; ETN-87-99955) Avail: Issuing Activity

The Columbus program and conceptual ideas for an autonomous, permanently manned space station Columbus are presented. The Columbus program, in its present state of definition, is discussed, with emphasis on the Man-Tended Freeflyer which is the key element for each potential autonomous European space station. The functions of such a space station and the infrastructure in space required for its operation are treated.

N87-26842 Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensgruppe Raumfahrt.

CONTROL ENGINEERING TASKS IN THE FRAMEWORK OF THE COLUMBUS PROGRAM [REGELUNGSTECHNISCHE AUFGABEN IM RAHMEN DES COLUMBUS-PROGRAMMS]

WERNER SOBOTTA In its Research and Development. Technical-Scientific Publications 1986 p 207-214 1986 In GERMAN Presented at a meeting, Boppard, West Germany, 20-21 Feb. 1986

(MBB-UR-E-912/86) Avail: Issuing Activity

The practical applicability of theoretically developed control systems and methods for control synthesis and optimization was checked and the necessary technology was developed in the framework of the Columbus program for the construction of an American-European space station. Navigation/rendezvous and docking (mission model at a height of 400 km); attitude control; the use of robotics and expert systems; life support systems; and experiment support are discussed.

N87-26953# Centre d'Etudes et de Recherches, Toulouse (France). Dept. Technologie Spatiale.
ON THE POSSIBILITY OF A SEVERAL-KILOVOLT DIFFERENTIAL CHARGE IN THE DAY SECTOR OF A

GEOSYNCHRONOUS ORBIT [SUR LA POSSIBILITE DE CHARGE DIFFERENTIELLE DE PLUSIEURS KILOVOLTS DANS LE SECTEUR JOUR DE L'ORBITE GEOSYNCHRONE]

L. LEVY, D. SARRAIL, J. P. PHILIPPON, J. P. CATANI, and J. M. FOURQUET (MATRA Service Aerodynamique, Toulouse, France) In AGARD, The Aerospace Environment at High Altitudes and its Implications for Spacecraft Charging and Communications 12 p May 1987 In FRENCH

Avail: NTIS HC A13/MF A01

Day-sector charging events detected with the Telecom 1-A satellite were analyzed. The temporal distribution of the events, seasonal variations, and correlations with geomagnetic activity are discussed. In addition, several covering materials were subjected to quasi-monoenergetic electron bombardment in a simulation chamber. It was found that floating metallic surfaces, although small, produced enduring discharges with short rise times. M.G.

N87-27687# Joint Publications Research Service, Arlington, Va. USSR REPORT: SPACE

21 Apr. 1986 140 p Transl. into ENGLISH from various Russian articles

(JPRS-USP-86-004) Avail: NTIS HC A07/MF A01

Topics addressed include: manned mission highlights, space sciences, interplanetary sciences, life sciences, space engineering, space applications, space policy and administration, and launch table.

N87-27688# Joint Publications Research Service, Arlington, Va. PRAVDA COMMENTARY, PHOTOS OF MIR ORBITAL STATION

A. POKROVSKIY In its USSR Report: Space p 3-8 21 Apr. 1986 Transl. into ENGLISH from Pravda (USSR), 21 Feb. 1986 p 1; 3

Avail: NTIS HC A07/MF A01

The Mir and Salyut space stations are compared, relative to mission accomplishments, docking ability, cabin space, crew comfort, efficiency, and crew productivity.

B.G.

N87-27693# Joint Publications Research Service, Arlington, Va. IKI DEPARTMENT HEAD ON ORBITAL POWER PLANTS

YURIY ZAITSEV In its USSR Report: Space p 67-69 21 Apr. 1986 Transl. into ENGLISH from APN: Advances of Science and Technology (Moscow, USSR), no. 22, 20 Nov. 1985 p 1-4

Avail: NTIS HC A07/MF A01

The depleting resources of fossil fuels and mankind's growing demand for energy necessitate the search for new sources of energy and revision of the approach to the old ones. The creation of solar power plants in near-earth orbit is discussed as a solution to the problem.

B.G.

N87-27695# Joint Publications Research Service, Arlington, Va. PROGRESS IN THEORY, TECHNOLOGY OF SPACE MATERIALS SCIENCE

YU. OSIPYAN *In its* USSR Report: Space p 97-99 21 Apr. 1986 Transl. into ENGLISH from Pravda (Moscow, USSR), 12 Nov. 1985 p 3

Avail: NTIS HC A07/MF A01

The crews on the Salyut-6 station conducted more than 200 melts and almost as many operations on spraying gold, copper, and various alloys and produced about 300 samples of various materials. Technical experiments now being conducted aboard the Salyut-7 are an important stage in the development of space materials science. Soviet scientists together with specialists from France, are creating equipment which must meet modern requirements from the gas phase and is distinguished by highly accurate temperature maintenance. Another unit is being created through co-operation of Soviet and British scientist. Its intended to study processes of low temperature crystallization out of solutions and promising methods of obtaining crystals of practical value.

N87-27698# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany). Space Div.

PRELIMINARY STUDY OF A BIOLOGICAL AND BIOCHEMICAL ANALYSIS FACILITY (BBAF) FOR COLUMBUS: EXECUTIVE SUMMARY Final Report

Paris, France ESA Nov. 1985 44 p Prepared in cooperation with Brunel Univ., Royal Netherlands Aircraft Factories Fokker. Schiphol-Oost, The Netherlands, ORS, Vienna, Austria, and Technical Univ., Graz, Austria

(Contract ESA-6607/85-F-HEW)

(ESA-CR(P)-2338; ETN-87-99987) Avail: NTIS HC A03/MF A01 The feasibility of a compact space laboratory for the performance of complex biological and biochemical assays in a microgravity environment is shown. The laboratory will provide service and support functions to other life science facilities in a common life science mission onboard the pressurized module of Colombus Space Station. Solution to problems due to the use of commercial hardware (for cost reasons) that may cause incompatibility problems (different electronics, etc.) and the limited resources of crew time available are proposed.

European Space Agency. European Space Research ESTEC, and Technology Center, Noordwijk (Netherlands).

#### SUMMARY OF RECENT SAR INSTRUMENT STUDIES

D. R. JANSSEN In its Proceedings of the SAR Applications Workshop p 111-119 Dec. 1986 Avail: NTIS HC A06/MF A01

Synthetic aperture radar SAR swath widening techniques were studied. Advanced SAR instruments were designed to cover at altitudes up to 900 km incidence angular ranges between 20 and 45 deg providing high image quality with dual frequency or twin SAR's. Broadside looking instruments with dual beam capability are favored. An instrument was sized to fit on the Columbus Polar Platform, which required a reduction of image quality and had to be limited to C-band. Detailed SAR instrument definition is in progress introduce digital to techniques for expansion/compression, and to provide antenna designs with dual beam capability with an optimum technology.

#### N87-28968# AEG-Telefunken, Wedel (West Germany). AMOC: AN ALTERNATIVE MODULE CONFIGURATION FOR **ADVANCED SOLAR ARRAYS IN LOW EARTH ORBITS**

JUERGEN W. KOCH In ESA Proceedings of the Fifth European Symposium on Photovoltaic Generators in Space p 63-70 Sponsored by ESTEC

Avail: NTIS HC A21/MF A01

A module concept, based on bifacial Si-solar cells, which also convert Earth albedo radiation to obtain an additional power gain was developed. Tests comprising 15,000 LEO-thermal cycles of real modules, irradiation tests, static load tests, and vibration tests with a fold stack in 2 configurations were conducted. The results show that the chosen design (bifacial cell, transparent substrate. long life interconnector) can meet LEO-mission requirements for extended lifetime.

#### N87-28974# AEG-Telefunken, Wedel (West Germany). IMPROVED SOLAR GENERATOR TECHNOLOGY FOR THE **EURECA LOW EARTH ORBIT**

LOTHAR GERLACH In ESA Proceedings of the Fifth European Symposium on Photovoltaic Generators in Space p 115-121 Nov.

Avail: NTIS HC A21/MF A01

The design and related activities of the electrical part of the EURECA solar array based on the shadow protection requirement and the extreme environment due to the atomic oxygen effects in the EURECA low Earth orbit combined with a high (20,000) number of thermal cycles are discussed. Tradeoff studies for the solar cell selection determined the optimum cell type in respect to power to mass ratio and cost effectiveness. The verification program is summarized and the solar cell technology to be applied for low Earth orbit missions with extended mission life (10 yr) equivalent to 60,000 thermal cycles is identified.

N87-28988# Societe Nationale Industrielle Aerospatiale, Cannes (France).

**AEROSPATIALE SOLAR ARRAYS, IN ORBIT PERFORMANCE** J. J. JUILLET, P. SAMSON, L. PELENC, G. HEESCHEN, and K. DETTLAFF (AEG-Telefunken, Wedel, West Germany) Proceedings of the Fifth European Symposium on Photovoltaic Generators in Space p 213-221 Nov. 1986

Avail: NTIS HC A21/MF A01

Correlation between on-ground prediction and in-orbit mechanical and electrical behavior for Telecom-1, ARABSAT, and SPOT solar arrays is shown. When recorded during the deployment phases, the current growth curves allow a good correlation between mechanical models and flight data. Flight data and the performance predictions are well correlated, within the measurement and model accuracies after adjustment of the cell data with ground flasher test results. For geostationary (GEO) missions, transfer orbit degradation may be due to an equivalent radiation dosage lower than usually computed (5 El3 e/sq cm). If so, mismatch and calibration losses may be neglected at BOL, for a nominal power output prediction, this being confirmed by SPOT 1 data analysis. Solar cell degradation due to radiation as observed at the beginning of missions seems to be compatible with an annual equivalent radiation dosage of 5 El3 e/sq cm for GEO missions, and very low for low orbits.

#### N87-28989# Genoa Univ. (Italy). Dipt. di Energetica. ORGANIC RANKINE CYCLE POWER CONVERSION SYSTEMS FOR SPACE APPLICATIONS

F. FARINA, C. MAO, and G. TUNINETTI (Ansaldo S.p.A., Genoa, Italy) In ESA Proceedings of the Fifth European Symposium on Photovoltaic Generators in Space p 225-230 Avail: NTIS HC A21/MF A01

Use of a Rankine heat engine in the Electric Power System (EPS) of a Space Station to convert heat into electricity is discussed. Concentrated solar energy is used to heat a working fluid which in turn drives a turbine operating in a Rankine cycle defined on the basis of the criteria required by a tens of kW EPS. For high reliability, long life, high power/mass ratio, and low collector and radiator area, procedures to optimize the selection of the system and to evaluate the influence of each component on the EPS performance are presented. Tests with toluene and PP3 are proposed.

N87-29015# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).

## ABSOLUTE INDOOR CALIBRATION OF LARGE AREA SOLAR

J. METZDORF, T. WITTCHEN, and H. KAASE In ESA Proceedings of the Fifth European Symposium on Photovoltaic Generators in Space p 397-401 Nov. 1986 Sponsored by the BMFT Avail: NTIS HC A21/MF A01

Equipment for the calibration of reference solar cells which is traceable back to their primary radiometric standards is presented. The apparatus, based on the differential spectral responsivity method is an absolute indoor procedure without reference solar cells, and needs no solar simulator. The method is applicable to all kinds of test devices up to solar cell areas of 10 x 10 cm without any requirements on linearity and spectral responsivity of the cells.

European Space Agency. European Space Technology Center, ESTEC, Noordwijk N87-29024# Research and (Netherlands).

#### SPACE 2000 IN EUROPE

K. REINHARTZ and H. STOEWER In its Proceedings of the Fifth European Symposium on Photovoltaic Generators in Space p 451-459 Nov. 1986

Avail: NTIS HC A21/MF A01

European space programs including the Columbus space station, Ariane 5, Hermes, Cluster, XMM, Comet Nucleus Sample Return Mission, Infrared Heterodyne Spectroscopy Mission, the microgravity program, the communications program, data relay systems, navigation systems, and space commercialization are summarized. **ESA** 

N87-29553# Joint Publications Research Service, Arlington, Va. **OPTIMIZING EXPERIMENTAL PROGRAMS IN OPERATIONAL** PLANNING OF RESEARCH CARRIED OUT FROM **SPACECRAFT Abstract Only** 

M. YU. BELYAYEV and D. N. RULEV In its JPRS Report: Science and Technology. USSR: Space p 37 19 Aug. 1987 into ENGLISH from Kosmicheskiye Issledovaniya (Moscow, USSR), v. 25, no. 1, Jan. - Feb. 1987 p 30-36 Avail: NTIS HC A08/MF A01

An integrated approach is given for optimal preparation of an experimental program for flights of orbital stations of the Salyut type. It is shown that operational planning of experiments is esentially a linear programming program. A set of programs for the BESM-6 computer was developed for use with this method. A Author specific example is given.

#### 19

#### SUPPORT SPACECRAFT

Includes design, analysis, requirements, trade studies and simulations of Space Station support spacecraft including the orbital transfer vehicle (OTV) and the orbital manuvering vehicle (OMV).

### A87-32549 **EVALUATION TESTING OF A MECHANICAL ACTUATOR** COMPONENT OPERATING IN A SIMULATED SPACE

YASUO KUMAGIRI, HARUKI MARUIZUMI, KOHE OHKAWA (Nissan Motor Co., Ltd., Aeronautical and Space Div., Tokyo, Japan), MAKOTO NISHIMURA, YOSHINORI FUJIMORI (National Aerospace Laboratory, Chofu, Japan) et al. IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2 . Tokyo, AGNE Publishing, Inc., 1986, p. 2041-2046.

The conceptual design and lubrication technology development for mechanical actuators for LEO applications are described. The actuators are to function in the deployment/retraction mechanism for a deployable mast for the Japanese experiment module (JEM). Details of the actuator housing are presented, including the interface between the Space Station and typical exposed experiment package to be manipulated. Experimental programs being followed to evaluate dry lubricants and processing technologies are outlined, noting the necessity of identifying areas of complex sliding and rolling friction and wear mechanisms, as well as the effects of space radiation. Electron beam irradiation of MoS2 resulted in no significant chemical or mechanical changes. The form further tests of more integrated systems will take is discussed.

#### A87-32598\* Air Force Space Div., Los Angeles, Calif. NATIONAL SPACE TRANSPORTATION STUDIES

CORT L. DUROCHER (USAF, Space Div., Los Angeles, CA), THOMAS M. IRBY (NASA, Marshall Space Flight Center, Huntsville, AL), JAMES C. JENKINS (Boeing Aerospace Co., Seattle, WA), and RAYMOND J. GORSKI (General Dynamics Corp., Space Systems, Div., San Diego, CA) SAE, Aerospace Technology Conference and Exposition, Long Beach, CA, Oct. 13-16, 1986. 17 p.

(SAE PAPER 861681)

This paper describes the government and industry activities and findings in response to a Presidential directive to study second-generation space transportation systems. Topics discussed include study purpose, mission needs, architecture development, system concepts, and technology recommendations. Interim study findings will also be presented. The study is being jointly managed by DOD and NASA and equally funded by DOD, NASA, and the Strategic Defense Initiative Organization. Author

#### A87-38783

#### THE NEXT STEP FOR THE MMU - CAPABILITIES AND **ENHANCEMENTS**

LESLIE J. A. ROGERS (Martin Marietta Corp., Denver, CO) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986 . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 883-889. (SAE PAPER 861013)

The Manned Maneuvering Unit (MMU) for untethered astronaut EVAs is a self-contained vehicle incorporating all electrical power, propulsion control, and display components required for such operations as satellite rendezvous, docking and stabilization, as well as the rescuing of crew members, satellite refueling and inspection, and assistance for on-orbit construction of space platforms. Attention is given to prospective improvements of MMU hardware to facilitate its use in Space Shuttle and NASA Space Station-related activities. These enhancements encompass a digital electronics assembly, a navigation aid, and a propellant tank kit.

#### A87-43031# **DESIGN PARAMETERS AND ENVIRONMENTAL** CONSIDERATIONS FOR A REUSABLE AEROASSISTED

G. R. JONES, M. J. GRUSZCZYNSKI, and K. D. WHITEHEAD (General Dynamics Corp., Space Systems Div., San Diego, CA) AIAA, Thermophysics Conference, 22nd, Honolulu, HI, June 8-10, 1987. 6 p. refs (AIAA PAPER 87-1505)

**ORBITAL TRANSFER VEHICLE** 

The factors of thermal protection system TPS design for a foldable, flexible aerobrake are discussed and documented in this study, which presents a practical design approach directed at a Centaur upper stage booster. The basics of the navigational guidance and control concerns are briefly described. Pertinent trades between number of aeropasses, TPS material sizing, and propellant weight to meet system mission requirements are presented. The heating environment and its impact on overall design are described. Several thermal and geometric models were constructed to perform prelimiary analysis and predict the thermal response of the TPS and selected Centaur components. The TPS simulation subjected the concept TPS to the expected heating environment. The increase in number of aeropasses results in reductions in heating rates, maximum temperatures on aerobrake face, and the maximum dynamic pressure but increases the total integrated heat load. These reductions are translated in design into reduced TPS insulation thickness and weight. The increase in the number of aeropasses also results in an increase in the amount of fuel required to complete the mission. Aerobrake backface temperatures and vortex-induced convection will be the predominant heating source for the protected vehicle during re-entry passes. Author

### A87-45441#

#### COMPOSITE FIBER/METAL SPACE STATION TANKAGE -APPLICATIONS, MATERIAL/PROCESS/DESIGN TRADES, AND SUBSCALE MANUFACTURING/TEST RESULTS

TONY M. PEARCE, DALE A. NEVERMAN, FRED J. DARMS, and EDGAR E. MORRIS (Harsco Corp., Structural Composites Industries Div., Pomona, CA) AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference, 23rd, San Diego, CA, June 29-July 2, 1987. 9 p.

(AIAA PAPER 87-2157)

Composite fiber/metal tanks are discussed, both their current uses and their specific Space Station applications. Design criteria are outlined. A detailed trade study is presented regarding selection of liner material and processing, fiber, resin, and operating pressure. Relationships between tank weight, fiber selection, and operating pressure are graphically illustrated. Resin and fiber selections as they apply to hypervelocity micrometeoroid impact are discussed. A scaled test demonstration of representative carbon/aluminum Author Space Station tankage is presented.

#### A87-50533#

# LINEAR QUADRATIC CONTROL SYSTEM DESIGN FOR SPACE STATION POINTED PAYLOADS

ROBERT O. HUGHES (General Electric Co., Astro-Space Div., Philadelphia, PA) IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 2. New York, American Institute of Aeronautics and Astronautics, 1987, p. 1247-1254. refs (AIAA PAPER 87-2530)

A pointing control design using Linear Quadratic techniques and a newly-derived flexible model for the Payload Pointing System (PPS) is developed. Sensitivity of control loop stability to PPS stiffness and damping for a previous PID control design is analyzed. Performance and stability comparisons for three models/controllers are made using both time domain and frequency domain techniques.

# N87-20633# Science Research Council, Chilton (England). REPORT OF THE ATMOSPHERE PANEL

J. E. HARRIES and H. FISCHER (Technische Univ., Munich, West Germany.) In ESA Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-sensing (ESPOIR) p 75-77 Nov. 1986

Avail: NTIS HC A07/MF A01

Policy issues governing the planning of an atmospheric element of a European Polar Platform program were debated. Instrument payloads and observation strategies are suggested.

# N87-20637# European Space Agency, Paris (France). PANEL REPORT ON MULTIDISCIPLINARY INSTRUMENTATION: NEW POSSIBILITIES

G. DUCHOSSOIS *In its* Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-sensing (ESPOIR) p 95-97 Nov. 1986

Avail: NTIS HC A07/MF A01

The utility of active microwave sensors, passive microwave sensors, high and medium resolution optical sensors, and active optics/laser sensors for the Columbus polar platform Earth observations was assessed. Recommendations concerning SAR, radar altimeters, wind scatterometers, rain radiometers and scatterometers, and microwave radiometers are made.

N87-21018\*# General Dynamics Corp., Huntsville, Ala. Advanced Space Programs.

# ORBITAL TRANSFER VEHICLE CONCEPT DEFINITION AND SYSTEM ANALYSIS STUDY. VOLUME 1A: EXECUTIVE SUMMARY. PHASE 2 Final Report

W. J. KETCHUM Dec. 1986 55 p Sponsored by NASA (NASA-CR-179055; NAS 1.26:179055; GDSS-SP-86-011-VOL-1A) Avail: NTIS HC A04/MF A01 CSCL 22B

The objectives of the Phase 2 study were to improve the orbit transfer vehicle (OTV) concept definition by focusing on the following issues: the impact of mission requirements on OTV system design; OTV basing concepts on the Space Shuttle, separate platforms, and/or remote locations; cost reduction of an OTV program to improve its economic benefits and support its acquisition. The OTV mission scenario includes a wide range of missions the main drivers of which are manned GEO servicing, mid-inclination/polar DOD, and lunar/planetary projects. A mission model is presented which includes the type and number of missions per year and the estimated propellant requirements. To accomplish the missions, many OTV concepts were defined including ground-based OTVs launched either in the STS orbiter, the aft cargo carrier, or a heavy lift launch vehicle, and a space-based OTV. System and program trade studies were conducted using performance, cost, safety/risk, and operations/growth criteria. The study shows that mission requirements and substantial economic benefits justify a reusable, cryogenic (H2/O2) space-based OTV. Such a system would not be subjected to Earth-to-orbit launch loads and would not be constained in size or weight. Safety is enhanced by the fact that the system components are launched unfueled. Its inherent reusability and ability to be refueled in space make the space-based OTV very economical to operate.

N87-23677# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

# A QUANTITATIVE COMPAŘISON OF SEVERAL ORBITAL MANEUVERING VEHICLE CONFIGURATIONS FOR SATELLITE REPAIR/REPLENISHMENT M.S. Thesis

JOSEPH H. CAVALLARO 16 Jun. 1987 75 p (AD-A179106; AFIT/GSO/AA/86D-2) Avail: NTIS HC A04/MF A01 CSCL 22A

The history of spaceflight is full of examples of astronaut crewmembers returning damaged/malfunctioning spacecraft to an operational status. The recent Space Shuttle rescues of Solar Max, Westar and Palapa B-11 are perhaps the most dramatic of these. The current operational concept of servicing the target vehicle on board the shuttle however limits the potential number of spacecraft which can be reached. A potential solution is to use the Orbital Maneuvering Vehicle (OMV) that NASA is developing as a multi-role spacecraft. Use of the OMV has the potential of extending the reach of servicing to spacecraft beyond the range of the Shuttle. This paper examines three OMV/Servicer configurations, including both telepresence and manned version. The Analytic Hierarchy Process is used to rank order the alternatives for further study. A computer program was used to solve for the weights of the various measures of the effectiveness, and resulting priority vector was calculated. Preliminary results show the telepresence servicer rated highest, followed by the full environment manned system.

N87-25582\* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. PRELOADABLE VECTOR SENSITIVE LATCH Patent
WILLIAM R. ACRES, inventor (to NASA) 28 Jul. 1987 13 p
Filed 3 Oct. 1985 Supersedes N86-19613 (24 - 10, p 1584)
(NASA-CASE-MSC-20910-1; US-PATENT-4,682,745;
US-PATENT-APPL-SN-783888; US-PATENT-CLASS-244-161;
US-PATENT-CLASS-292-DIG.49; US-PATENT-CLASS-292-201;
US-PATENT-CLASS-292-64) Avail: US Patent and Trademark
Office CSCL 13K

A preloadable vector-sensitive latch which automatically releases when the force vector from a latch memebr reaches a specified release angle is presented. In addition, it contains means to remove clearance between the latched members and to preload the latch to prevent separation at angles less than the specified release angle. The latch comprises a triangular main link, a free link connected between a first corner of the main link and a yoke member, a housing, and an actuator connected between the yoke member and the housing. A return spring bias means connects the main link to a portion of the housing. A second corner of the main link is slidably and pivotally connected to the housing via a slot in a web portion of the housing. The latch housing has a rigid docking ring alignable with a mating locking ring which is engageable by a locking roller journalled on the third corner of the triangular main link.

Official Gazette of the U.S. Patent and Trademark Office

## N87-29861\*# University Coll. of North Wales, Bangor. A MICROGRAVITY ISOLATION MOUNT

D. I. JONES, A. R. OWENS, R. G. OWEN, G. ROBERTS, D. W. WYN-ROBERTS, and A. A. ROBINSON (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) In NASA-Lyndon B. Johnson Space Center, The 21st Aerospace Mechanisms Symposium 35-54 May 1987

Avail: NTIS HC A16/MF A01 CSCL 13I

The design and preliminary testing of a system for isolating microgravity sensitive payloads from spacecraft vibrational and impulsive disturbances is discussed. The Microgravity Isolation Mount (MGIM) concept consists of a platform which floats almost freely within a limited volume inside the spacecraft, but which is constrained to follow the spacecraft in the long term by means of very weak springs. The springs are realized magnetically and form part of a six degree of freedom active magnetic suspension system. The latter operates without any physical contact between the spacecraft and the platform itself. Power and data transfer is also

performed by contactless means. Specifications are given for the expected level of input disturbances and the tolerable level of platform acceleration. The structural configuration of the mount is discussed and the design of the principal elements, i.e., actuators, sensors, control loops and power/data transfer devices are described. Finally, the construction of a hardware model that is being used to verify the predicted performance of the MGIM is described.

N87-29876\*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

# THE PRELOADABLE VECTOR SENSITIVE LATCH FOR ORBITAL DOCKING/BERTHING

WILLIAM R. ACRES and JOHN J. KENNEDY
Aerospace Mechanisms Symposium p 247-259
Avail: NTIS HC A16/MF A01 CSCL 13I

In its The 21st May 1987
Avail: NTIS HC A16/MF A01 CSCL 13I

The workings and function of the Preloader Vector Sensitive Latch are described. A discussion of docking systems used in the U.S. manned space flight programs is included to show how docking systems have evolved, and to highlight the potential advantages of a preloadable vector sensitive latch in such systems. Author

#### 20

## LIFE SCIENCES/HUMAN FACTORS/SAFETY

Includes studies, models, planning, analyses and simulations for biological and medical laboratories, habitability issues for the performance and well-being of the crew, and crew rescue.

#### A87-33001 HUMAN FACTORS SOCIETY, ANNUAL MEETING, 30TH, DAYTON, OH, SEPT. 29-OCT. 3, 1986, PROCEEDINGS.

Meeting supported by the Human Factors Society, USAF, University of Dayton, et al. Santa Monica, CA, Human Factors Society, 1986. Vol. 1, 758 p.; vol. 2, 754 p. For individual items see A87-33002 to A87-33073.

The conference presents papers on the habitability and facilities of space environments, Forecast II, the validation and application of the criterion task set, visual display research, three-dimensional anthropometry, lifting, visual processes and visual detection, human factors in space, and simulator aftereffects. Other topics include the integration and display of multidimensional information, human factors applications in nonmilitary systems, aviation psychology, design applications in consumer products, and the evaluation of display characteristics. Particular attention is given to the super cockpit and its human factors challenges; individual differences in criterion task set performance; linguistic processing; the use of eye control to select switches; simulated daylight; multimodal interfaces in supervisory control; man/system integration standards for space systems; and USAF experience with simulator sickness, K.K. research, and training.

#### A87-33002 ISOKIN - A QUANTITATIVE MODEL OF THE KINESTHETIC ASPECTS OF SPATIAL HABITABILITY

DAVID B. LANTRIP (Washington, University, Seattle) IN: Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volume 1 Santa Monica, CA, Human Factors Society, 1986, p. 33-37.

This paper describes a model of the kinesthetic aspect of spatial habitability which is being developed for NASA as a means of assessing the volumetric requirements for the Space Station. The quantitative model, called ISOKIN, defines the level and type of constraint that a confining space imposes on its occupant. An activity will be constrained either in the ways it can be performed (that is, performer adaptation may be required) or in the positions where it can be performed (no adaptation required). This model provides both the analyst and the designer the means to

operationalize and measure formerly intuitive notions about the suitability of various proposed Space Station internal configurations for the activities being planned for them.

Author

#### 487-33021

### **HUMAN PERFORMANCE IN SPACE**

DAVID M. REGAL (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) IN: Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volume 1 . Santa Monica, CA, Human Factors Society, 1986, p. 365-369.

Space provides a unique living and working environment. Humans in space are, in many respects, different creatures than their earth-bound counterparts (e.g., they float). The paper describes some of the ways in which human capabilities in space are different from those on earth. Psychological and social factors that can affect crew performance on long-duration space missions are discussed.

#### A87-33022

## HUMAN FACTORS STANDARDS FOR SPACE HABITATION

BARRY TILLMAN (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) IN: Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volume 1. Santa Monica, CA, Human Factors Society, 1986, p. 370-373.

NASA is developing a Man/System Integration Standard. It is to be a single source for human factors engineering standards for the design and development of space habitats. Included in this paper is a discussion of the Anthropometrics, Architecture, Activity Centers, and Health Management sections of the standard. There is a brief description of the general contents of each of these sections and some of the human factors considerations that are unique to the space environment.

#### A87-33475

LIVING IN SPACE: A HANDBOOK FOR SPACE TRAVELLERS
PETER SMOLDERS (Wonen in de ruimte, Bussum, Netherlands,
Unieboek, 1985) Blue Ridge Summit, PA, Tab/Aero, 1986, 159 p.
Translation.

The state of the art in manned space flight as of 1985 is surveyed and illustrated with extensive drawings and photographs, with an emphasis on the on-orbit living conditions and activities of astronauts on the Space Shuttle and the planned Space Station. Consideration is given to the Shuttle launch facilities; the Shuttle Orbiter; a typical mission profile; the habitat modules for the Space Station; eating, drinking, sleeping, etc. in space; space manufacturing; past Salyut, Skylab, and Spacelab missions; and proposals for colonizing the moon, Mars, and Venus.

#### A87-35599

### SAFETY ON THE SPACE STATION

MAURA J. MACKOWSKI Space World (ISSN 0038-6332), vol. X-3-279, March 1987, p. 22-24.

Safety features which are either being designed in or considered for the Space Station are discussed briefly. The overall design approach is that of a safe haven, where all modules are independent units to which crew can retreat. The major hazards are fire, meteor impact, or the internal release of hazard materials. Fire extinguishing equipment that was flown on the Gemini, Apollo and Skylab missions is reviewed for the relevancy to the Space Station. A leading design option is a computer-controlled monitoring system that could flood a module with Halon 1301, backed up by portable extinguishers. Several manufacturers are independently pursuing studies of lifeboats for permitting up to seven crewmembers to abandom the Station and parachute to earth in life-threatening emergency.

#### A87-38701

AEROSPACE ENVIRONMENTAL SYSTEMS; PROCEEDINGS OF THE SIXTEENTH INTERSOCIETY CONFERENCE ON ENVIRONMENTAL SYSTEMS, SAN DIEGO, CA, JULY 14-16, 1986

Conference sponsored by SAE. Warrendale, PA, Society of

Automotive Engineers, Inc. (SAE P-177), 1986, 908 p. For individual items see A87-38702 to A87-38784.

(SAE P-177)

The present conference discusses integrated aircraft fuel thermal management, aircraft fog control systems, food and nutrition in manned spacecraft, a NASA Space Station health maintenance facility. Space Station personal hygiene, radiation dose prediction for the Space Station, the NASA Space Station's Habitation Module, an analysis of crew functions as an aid in Space Station interior layout, the thermal performance of Giotto, systems aspects of Columbus thermal control, and regenerative life support system hardware testing. Also considered are a comparison of environmental control and life support systems requirements for nuclear submarines and the NASA Space Station, space suit reach and strength envelope considerations, an EVA universal work station, a thermal analyzer for two-phase loops, a cryogenic methane heat pipe diode, Space Station air revitalization, long duration botanical experiments in space, plant and animal accommodations aboard the Space Station, spacecraft water recovery, physiological aspects of EVA, the integrated management of water and wastes, and advanced extravehicular enclosures.

## A87-38713

#### **ENERGY EXPENDITURE DURING SIMULATED EVA WORKLOADS**

REBECCA S. INDERBITZEN (USAF, School of Aerospace Medicine, Brooks AFB, TX) and JAMES J. DECARLIS, JR. IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986 . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 109-112. refs (SAE PAPER 860921)

In ongoing decompression sickness studies at the USAF School of Aerospace Medicine, an exercise regimen is used in which EVA is simulated. A ground-based study was undertaken in order to assess, for the protocol, the currently accepted value of energy expenditure (150-200 kcal/hr) which was based on very limited data. Six male and five female subjects performed an hour of exerise comprised of three tasks analogous to actual tasks performed by astronauts during EVA. Metabolic data were collected using an open-loop oxygen consumption meter during rest and exercise. Gender differences in energy expenditure during performance disappeared when the values were expressed in terms of added energy cost, body weight or lean-body mass.

National Aeronautics and Space Administration. A87-38714\* Lyndon B. Johnson Space Center, Houston, Tex. SPACE MOTION SICKNESS STATUS REPORT

FRANK KUTYNA (NASA, Johnson Space Center, Houston, TX) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986 . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 119-121.

(SAE PAPER 860923)

The space motion sickness (SMS) component of the multifactor space adaptation syndrome is anticipated to be a major problem in the spaceflight and habitation conditions that will be encountered in NASA Space Station tours and Mars voyages. The minimization of maladaptive physiological responses while enhancing those mechanisms that can best cope with the gravitoinertial conditions of space flight will require an intimate knowledge of the physiology of adaptive processes. The homeostatic mechanisms involved in SMS are inherent in human physiology.

#### HYPERBARIC OXYGEN THERAPY FOR DECOMPRESSION **ACCIDENTS - POTENTIAL APPLICATIONS TO SPACE** STATION OPERATION

ANDREW A. PILMANIS (Southern California, University, Catalina, IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San

Diego, CA, July 14-16, 1986 . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 151-160. (SAE PAPER 860927)

The USN's hyperbaric oxygen treatment consists of the administering of 100 percent O2 intermittently to a subject in a hyperbaric chamber, at pressures of 2.73 and 1.82 ATA, and equal parts N2 and O2 at 6.0 ATA. Attention is presently given to the pathophysiology of air embolism and decompression sickness, the basic rationale and goals of hyperbaric oxygen therapy, and the specific treatment tables used by the USN Hyperbaric Chamber Facility, with a view to the application of hyperbaric oxygen therapy for EVA decompression accidents in the future NASA Space Station.

#### **A87-38718**

## HABITATION MODULE FOR THE SPACE STATION

GARY JOHNSON, HARRY L. WOLBERS, JR., and WILLIAM L. MILES (McDonnell Douglas Astronautics Co., Huntington Beach, IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986 . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 161-174. (SAE PAPER 860928)

The habitability requirements of the NASA Space Station, which must support crews for minimum periods of 90 days, are conditioned by the drawing of crewmembers from a wider population than that of the professional astronaut community and the requirement for high crew productivity. Modularity, interchangeability of functional units, commonality of hardware and software, and reconfigurability for changing mission needs and expansion, are additional requirements. The architecture presently proposed consists of longitudinally arranged standoff structural elements attached to the cylindrical pressure wall, through which the common utilities are distributed and to which the modular equipment racks and functional units are attached.

A87-38721\* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. SPACE STATION PERSONAL HYGIENE STUDY

STEPHEN E. PREJEAN (Presearch, Inc., Houston, TX) and CLETIS R. BOOHER (NASA, Johnson Space Center, Houston, TX) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986 . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 185-200. (SAE PAPER 860931)

A personal hygiene system is currently under development for Space Station application that will provide capabilities equivalent to those found on earth. This paper addresses the study approach for specifying both primary and contingency personal hygiene systems and provisions for specified growth. Topics covered are system definition and subsystem descriptions. Subsystem interfaces are explored to determine which concurrent NASA study efforts must be monitored during future design phases to stay up-to-date on critical Space Station parameters. A design concept for a three (3) compartment personal hygiene facility is included as a baseline for planned test and verification activities.

A87-38724\* McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.

### ANALYSIS OF CREW FUNCTIONS AS AN AID IN SPACE STATION INTERIOR LAYOUT

A. L. STEINBERG, THOMAS S. TULLIS, and BARBRA BIED (McDonnell Douglas Astronautics Co., Huntington Beach, CA) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986 . Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 215-224. refs (Contract NAS2-11723)

(SAE PAPER 860934)

The Space Station must be designed to facilitate all of the functions that its crew will perform, both on-duty and off-duty, as efficiently and comfortably as possible. This paper examines the functions to be performed by the Space Station crew in order to make inferences about the design of an interior layout that optimizes crew productivity. Twenty-seven crew functions were defined, as well as five criteria for assessing relationships among all pairs of those functions. Hierarchical clustering and multidimensional scaling techniques were used to visually summarize the relationships. A key result was the identification of two dimensions for describing the configuration of crew functions: 'Private-Public' and 'Group-Individual'. Seven specific recommendations for Space Station interior layout were derived from the analyses.

Autho

#### A87-38739 THE DEVELOPMENT OF AN EVA UNIVERSAL WORK STATION

MILES MOFFATT and FRED ABELES (Grumman Corp., Bethpage, NY) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 397-403. (SAE PAPER 860952)

The design requirements for a Space Station-associated EVA Universal Work Station (UWS) which will reduce the overhead costs accruing to multiple trips to and from work sites while increasing crew safety, are discussed. The requirements are established by the variety of work sites and many different EVA tasks, which are characterizable in terms of EVA duration, job performance requirements, work envelope considerations, and translation times. As a result of mission analyses, several design recommendations are made for the EVA UWS system; setup and breakdown time at the work site is noted to be greatly reduced by implementing dedicated work stations at areas of frequent EVA. Tools stored on the UWS, and procedures that are assessed via display system, allow the astronauts to perform the required tasks productively and autonomously.

A87-38740\* National Aeronautics and Space Administration.
Ames Research Center, Moffett Field, Calif.
SCIENCE AND PAYLOAD OPTIONS FOR ANIMAL AND PLANT
RESEARCH ACCOMMODATIONS ABOARD THE EARLY

SPACE STATION
JOHN D. HILCHEY (NASA, Marshall Space Flight Center, Huntsville, AL), ROGER D. ARNO (NASA, Ames Research Center, Moffett Field, CA), EDITH GUSTAN (Boeing Aerospace Co., Seattle, WA), and C. E. RUDIGER (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 405-426. refs (SAE PAPER 860953)

The resources to be allocated for the development of the Initial Operational Capability (IOC) Space Station Animal and Plant Research Facility and the Growth Station Animal and Plant Vivarium and Laboratory may be limited; also, IOC accommodations for animal and plant research may be limited. An approach is presented for the development of Initial Research Capability Minilabs for animal and plant studies, which in appropriate combination and sequence can meet requirements for an evolving program of research within available accommodations and anticipated budget constraints.

#### A87-38741 SPECIAL CONSIDERATIONS IN OUTFITTING A SPACE STATION MODULE FOR SCIENTIFIC USE

CARL E. RUDIGER, CINDY J. HARRIS, and PAUL C. DOLKAS (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 427-433. (SAE PAPER 860956)

This paper addresses some of the key issues involved with

outfitting a space station module for life sciences research, namely the integration of a large diameter centrifuge for holding control specimens at 1 G (or fractions thereof); accommodating international participation in the design and construction of key elements of the lab module (including the module itself); and maintaining biological isolation between the experimental animals and the crew. Several design concepts are presented that address these specific issues. Centrifuge vibration - once thought to be a major problem in a station that also houses materials technology experiments - will be virtually eliminated by the use of an active magnetic suspension and automated rotor balancing. Bioisolation is provided by housing the animals in special isolator cages and performing all experimental work in a laminar flow isolation houses.

**A87-38751\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

# CONCEPTUAL PLANNING FOR SPACE STATION LIFE SCIENCES HUMAN RESEARCH PROJECT

GARY R. PRIMEAUX (NASA, Johnson Space Center, Houston, TX), LADONNA J. MILLER, and ROGER B. MICHAUD (GE Management and Technical Services Co., Houston, TX) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 531-537. refs (SAE PAPER 860969)

The Life Sciences Research Facility dedicated laboratory is currently undergoing system definition within the NASA Space Station program. Attention is presently given to the Humam Research Project portion of the Facility, in view of representative experimentation requirement scenarios and with the intention accommodating the Facility within the Initial Operational Capability configuration of the Space Station. Such basic engineering questions as orbital and ground logistics operations and hardware maintenance/servicing requirements are addressed. Biospherics, calcium homeostasis, endocrinology, exercise physiology, hematology, immunology, muscle physiology, neurosciences, radiation effects, and reproduction and development, are among the fields of inquiry encompassed by the Facility.

## A87-38768 PHYSIOLOGICAL ASPECTS OF EVA

PAUL A. FURR, CONRAD B. MONSON, WILLIAM J. SEARS, and FRED J. ABELES (Grumman Aerospace Corp., Space Systems Div., Bethpage, NY) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 711-718. refs (SAE PAPER 860991)

Extravehicular activity (EVA) has become increasingly complex since the days of Gemini. Crewmembers may accumulate as many as 250 hours EVA during a 90 day mission. Physiological parameters and operational variables which were of little or no concern on Shuttle EVAs may become major factors for Space Station EVAs in terms of limiting man's productivity and thus impact EVA scheduling, tasks, and safety. Repeated decompressions, suit oxygen and carbon dioxide levels, metabolic requirements for optimization of work, thermal balance and comfort, and waste collection and management are discussed in this paper. The physiologist must determine the limits of man's adaptation to the space environment within the context of defined, measurable parameters of work performance, or define the change in performance when given an altered environment as the independent variable.

#### A87-40098

PROPOSED APPLICATION OF AUTOMATED BIOMONITORING FOR RAPID DETECTION OF TOXIC SUBSTANCES IN WATER SUPPLIES FOR PERMANENT SPACE STATIONS

ERIC L. MORGAN (Tennessee Technological University, Cookeville), MICHAEL D. SMITH (Tennessee Valley Authority,

Knoxville), KENNETH W. EAGLESON (North Carolina Department of Natural Resources and Human Development, Raleigh), and RICHARD C. YOUNG (Institute of Environmental Sciences, Space Simulation Conference, 14th, Baltimore, MD, Nov. 1986) Journal of Environmental Sciences (ISSN 0022-0906), vol. 30, Mar.-Apr. 1987, p. 47-49. refs

The objective of this study was to present proposed design characteristics and applications of automated biomonitoring devices for real-time toxicity detection in drinking water supplies on-board permanent space stations. Tests in transmissions of automated biomonitoring data to earth-receiving stations were simulated using satellite data linkage from remote earth-based stations. Emphasis was placed on developing methods for detecting species-specific bioelectric potentials produced by unrestrained bivalve mussels and other sedentary invertebrates since these animals are presumably more easily maintained in near zero gravity than fish. In achieving this objective, differential amplifiers were constructed for measuring a wide range of response signals induced by various biological activities from fish and invertebrate subjects. Specific responses were detected as discrete analog signals, each converted to a digital voltage, and filed in computer storage. A management program provided various means for data gathering, filing, and retrieval.

#### A87-53089

## **HUMAN CAPABILITIES IN SPACE**

BYRON K. LICHTENBERG (Payload Systems, Inc., Wellesley, MA) IN: The human quest in space; Proceedings of the Twenty-fourth Goddard Memorial Symposium, Greenbelt, MD, Mar. 20, 21, 1986. San Diego, CA, Univelt, Inc., 1987, p. 183-194. (AAS PAPER 86-114)

The role of humans in space is discussed. The crew is concerned with flying the vehicle, operating experiments, participating in biomedical studies, and exploring outside the spacecraft. The use of the crew to construct large structures, such as the Space Station, in space and the functions of the crew on the Space Station are examined.

**N87-20325\***# Colorado Univ., Boulder. Dept. of Aerospace Sciences.

# THE GROWTH AND HARVESTING OF ALGAE IN A MICRO-GRAVITY ENVIRONMENT

NANCY L. WILTBERGER *In* NASA. Goddard Space Flight Center The 1986 Get Away Special Experimenter's Symposium p 163-170 Feb. 1987

Avail: NTIS HC A11/MF A01 CSCL 22A

Algae growth in a micro-gravity environment is an important factor in supporting man's permanent presence in space. Algae can be used to produce food, oxygen, and pure water in a manned space station. A space station is one example of a situation where a Controlled Ecological Life Support System (CELSS) is imperative. In setting up a CELSS with an engineering approach at the Aerospace department of the University of Colorado, questions concerning algae growth in micro-g have arisen. The Get Away Special (GAS) Fluids Management project is a means through which many questions about the effects of a micro-g environment on the adequacy of growth rates, the viability of micro-organisms, and separation of gases and solids for harvesting purposes can be answered. In order to be compatible with the GAS tests, the algae must satisfy the following criteria: (1) rapid growth rates, (2) sustain viability over long periods of non-growth storage, and (3) very brief latency from storage to rapid growth. Testing indicates that the overall growth characteristics of Anacystis Nidulans satisfy the specifications of GAS's design constraints. In addition, data acquisition and the method of growth instigation are two specific problems being examined, as they will be encountered in interfacing with the GAS project. Flight testing will be two-fold, measurement of algae growth in micro-g and separation of algae from growth medium in an artificial gravitation field. Post flight results will provide information on algae viability in a micro-g environment as reflected by algal growth rates in space. Other post flight results will provide a basis for evaluating techniques for harvesting algae. The results

from the GAS project will greatly assist the continuing effort of developing the CELSS and its applications for space. Author

N87-20342\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

## FIRE SAFETY CONCERNS IN SPACE OPERATIONS

ROBERT FRIEDMAN 1987 13 p Prepared for presentation at the Joint Army-Navy-NASA-Air Force (JANNAF) Safety and Environmental Protection Subcommittee Meeting, Cleveland, Ohio, 4-7 May 1987

(NASA-TM-89848; E-3511; NAS 1.15:89848) Avail: NTIS HC A02/MF A01 CSCL 22A

This paper reviews the state-of-the-art in fire control techniques and identifies important issues for continuing research, technology, and standards. For the future permanent orbiting facility, the space station, fire prevention and control calls for not only more stringent fire safety due to the long-term and complex missions, but also for simplified and flexible safety rules to accommodate the variety of users. Future research must address a better understanding of the microgravity space environment as it influences fire propagation and extinction and the application of the technology of fire detection, extinguishment, and material assessment. Spacecraft fire safety should also consider the adaptation of methods and concepts derived from aircraft and undersea experience. Author

N87-21585\*# Southern California Inst. of Architecture, Santa Monica. Inst. for Future Studies.

# SPACE STATION GROUP ACTIVITIES HABITABILITY MODULE STUDY Final Report

DAVID NIXON Washington NASA 1986 109 p (Contract NCC2-356)

(NASA-CR-4010; NAS 1.26:4010) Avail: NTIS HC A06/MF A01 CSCL 06K

This study explores and analyzes architectural design approaches for the interior of the Space Station Habitability Module (originally defined as Habitability Module 1 in Space Station Reference Configuration Decription, JSC-19989, August 1984). In the Research Phase, architectural program and habitability design guidelines are specified. In the Schematic Design Phase, a range of alternative concepts is described and illustrated with drawings, scale-model photographs and design analysis evaluations. Recommendations are presented on the internal architectural, configuration of the Space Station Habitability Module for such functions as the wardroom, galley, exercise facility, library and station control work station. The models show full design configurations for on-orbit performance.

N87-22744\*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.

# CREW ACTIVITY AND MOTION EFFECTS ON THE SPACE STATION

BRIAN V. ROCHON and STEVEN A. SCHEER In NASA. Marshall Space Flight Center Structural Dynamics and Control Interaction of Flexible Structures p 1095-1160 Apr. 1987 (Contract NAS9-15800)

Avail: NTIS HC A99/MF E03 CSCL 22B

Among the significant sources of internal disturbances that must be considered in the design of space station vibration control systems are the loads induced on the structure from various crew activities. Flight experiment T013, flown on the second manned mission of Skylab, measured force and moment time histories for a range of preplanned crew motions and activities. This experiment has proved itself invaluable as a source of on-orbit crew induced loads that has allowed a space station forcing function data base to be built. This will enable forced response such as acceleration and deflections, attributable to crew activity, to be calculated. The flight experiment, resultant database and structural model pre-processor, analysis examples and areas of combined research shall be described.

N87-25561\*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va. VAPOR FRAGRANCER Patent Application Q. TRAN SANG, inventor (to NASA) and TIMOTHY D. BRYANT, inventor (to NASA) 22 May 1987 9 p (NASA-CASE-LAR-13680-1; US-PATENT-APPL-SN-052941) Avail: NTIS HC A02/MF A01 CSCL 14B

This invention relates to a vapor fragrancer for continuously, uniformly, and economically odorizing or deodorizing an environment. Homes, offices, automobiles, and space stations require either odorizing or deodorizing of the atmosphere to create pleasant conditions for work or leisure. A vapor fragrancer is provided to accomplish these goals. A supplier continuously supplies a predetermined amount of desired liquid fragrance from a container to a retaining material, which is positioned in the circulation path of the atmosphere. The supplier is either a low powered pump or a gravity dispenser. The atmosphere flowing in a circulation path passes over the retaining material containing the liquid fragrance and lifts a fragrant vapor from the retaining material. The atmosphere is thereby continuously and uniformly fragranced.

#### 21

#### **GENERAL**

Includes descriptions, analyses, trade studies, commercial opportunities, published proceedings, seminars, hearings, historical summaries, policy speeches and statements that have not previously been included.

A87-25396\*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

# THE EFFECT OF CIRCUMFERENTIAL AERODYNAMIC DETUNING ON COUPLED BENDING-TORSION UNSTALLED SUPERSONIC FLUTTER

D. HOYNIAK (NASA, Lewis Research Center, Cleveland, OH) and S. FLEETER (Purdue University, West Lafayette, IN) ASME, Transactions, Journal of Turbomachinery (ISSN 0889-504X), vol. 108, Oct. 1986, p. 253-260. Previously announced in STAR as N86-21513. refs

(ASME PAPER 86-GT-100)

A mathematical model developed to predict the enhanced coupled bending-torsion unstalled supersonic flutter stability due to alternate circumferential spacing aerodynamic detuning of a turbomachine rotor. The translational and torsional unsteady aerodynamic coefficients are developed in terms of influence coefficients, with the coupled bending-torsion stability analysis developed by considering the coupled equations of this aerodynamic detuning on coupled bending-torsion unstalled supersonic flutter as well as the verification of the modeling are then demonstrated by considering an unstable 12 bladed rotor, with Verdon's uniformly spaced Cascade B flow geometry as a baseline. However, with the elastic axis and center of gravity at 60 percent of the chord, this type of aerodynamic detuning has a minimal effect on stability. For both uniform and nonuniform circumferentially space rotors, a single degree of freedom torsion mode analysis was shown to be appropriate for values of the bending-torsion natural frequency ratio lower than 0.6 and higher 1.2. When the elastic axis and center of gravity are not coincident, the effect of detuning on cascade stability was found to be very sensitive to the location of the center of gravity with respect to the elastic axis. In addition, it was determined that when the center of gravity was forward of an elastic axis located at midchord, a single degree of freedom torsion model did not accurately predict Author cascade stability.

A87-32017\* National Aeronautics and Space Administration, Washington, D.C.

SPACE RESEARCH - AT A CROSSROADS

FRANK B. MCDONALD (NASA, Washington, DC) Science (ISSN 0036-8075), vol. 235, Feb. 13, 1987, p. 751-754.

Efforts which must be expended if U.S. space research is to

regain vitality in the next few years are discussed. Small-scale programs are the cornerstone for big science projects, giving both researchers and students a chance to practice the development of space missions and hardware and identify promising goals for larger projects. Small projects can be carried aloft by balloons, sounding rockets, the Shuttle and ELVs. It is recommended that NASA continue the development of remote sensing systems, and join with other government agencies to fund space-based materials science, space biology and medical research. Increased international cooperation in space projects is necessary for affording moderate to large scale missions, for political reasons, and to maximize available space resources. Finally, the establishment and funding of long-range goals in space, particularly the development of the infrastructure and technologies for the exploration and colonization of the planets, must be viewed as the normal outgrowth of the capabilities being developed for LEO operations.

# A87-32276 INTERNATIONAL SYMPOSIUM ON SPACE TECHNOLOGY AND SCIENCE, 15TH, TOKYO, JAPAN, MAY 19-23, 1986, PROCEEDINGS. VOLUMES 1 & 2

HIROKI MATSUO, ED. (Tokyo, University, Japan) Symposium sponsored by Ad-Melco Co., Ltd., Fujitsu, Ltd., Hitachi, Ltd., et al. Tokyo, AGNE Publishing, Inc., 1986. Vol. 1, 1159 p.; vol. 2, 1111 p. For individual items see A87-32277 to A87-32571.

Papers are presented on national space programs, the future utilization of space, propulsion, materials and structure, flight dynamics and astrodynamics, fluid dynamics, and thermophysics and thermochemistry. Topics discussed include electronic components and devices, space communications, guidance, navigation, and control, systems engineering, space transportation systems. Consideration is given to balloons, space science, the Space Station and space platforms, life sciences, and microgravity.

## A87-32286 SPACE COLONIZATION - T MINUS 20 (YEARS) AND

HAROLD J. JEBENS (Marquip, Inc., Phillips, WI) and RICHARD D. JOHNSON (SRI International, Menlo Park, CA) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 1 . Tokyo, AGNE Publishing, Inc., 1986, p. 67-71. refs

The paper summarizes the findings of a System Design Study undertaken in 1975. The study concluded that a permanent human community for 10,000 people could be placed in space within a 20-year time frame. The paper outlines the objectives of the study, reviews the rational for selecting the location at L5, presents the physiological constraints that dictated the geometry of the habitat, and reviews the economic considerations of the system. Author

# A87-32460 COMMERCIALIZATION OF SPACE - THE INSURANCE IMPLICATIONS

BRIAN STOCKWELL and PATRICK OFLAHERTY (Corroon and Black Inspace, Inc., Washington, DC) IN: International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volume 2 . Tokyo, AGNE Publishing, Inc., 1986, p. 1365-1372.

The extent of private sector participation in the commercialization of space will be substantially influenced by the availability and cost of insurance. At present, full insurance costs over the lifetime of a communications satellite may amount to an additional 50 percent or more of the cost of construction and launch. The impact of satellite losses in 1984-1985 led to a reduction of insurance capacity from \$250 million to less than \$100 million. An evaluation is presently made of the space insurance cost and availability prospects for the 1990s; governmental participation in insurance; the cost tradeoffs between increased design, testing, and redundancy by comparison to attendant reductions in insurance needs and costs; and alternatives to traditional space insurance.

**A87-33019\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

MANNED SPACE FLIGHT

BARBARA J. WOOLFORD (NASA, Johnson Space Center, Houston, TX) IN: Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volume 1 . Santa Monica, CA, Human Factors Society, 1986, p. 354-357. refs

An overview of manned space flight is given. This describes the key goals and achievements of the space programs of the United States and of the Soviet Union. The importance of the 'Man' in manned space flight is emphasized. Human factors are shown to have played an ever increasing role in the design of manned spacecraft.

Author

#### A87-34597

# THE STATION IS RAISING LOTS OF QUESTIONS ABOUT SPACE LAW

Commercial Space (ISSN 8756-4831), vol. 2, no. 4, Winter 1987, p. 43, 45.

The U.S./international space station program may give rise to unprecedented legal questions when it becomes operational, questions involving disputes opver such things as criminal activity on the station, industrial espionage, intellectual property rights in space, export law, and product liability, agreements among the four space partners - the U.S., Canada, Japan, and the European Space Agency - are needed to clarify the legal questions. Experts believe that some existing laws can be transferred to space, but others will be inapplicable. If the U.S. were to assert sole jurisdiction over the station, other countries could choose to withdraw their participation. Having 'national enclaves' aboard the station is unacceptable to the U.S. Setting up an international governmental organization, such as Intelsat, might be a possibility. A measure to extend U.S. patent laws to cover devices invented aboard launch vehicles and spacecraft is expected to be brought up again during the current legislative session. Although some members of Congress are concerned about adequate protection of U.S. interests, some experts think it would be best to wait and write the laws when the need for them is specifically evident.

## A87-34870

### INNOVATIONS IN SPACE MANAGEMENT -MACROMANAGEMENT AND THE NASA HERITAGE

PHILIP R. HARRIS (Harris International, La Jolla, CA) British Interplanetary Society, Journal (Space Chronicle) (ISSN 0007-084X), vol. 40, March 1987, p. 109-116.

Under the leadership of NASA and the National Commission on Space, plans are underway for the next 25 to 50 years in space developments. At the minimum, it involves space and lunar stations that will be complicated to construct and manage, require a new generation of technology, and cost billions of dollars. From these bases in space, planners envision the mining of the moon, then the asteroids, and eventually manned missions to Mars. For such to happen will require an organizational transformation of the National Aeronautics and Space Administration. This may involve changes that give the agency more autonomy and flexibility, especially for long-term financing. Certainly, it should include planned organization renewal so that NASA builds upon the technological and management innovations of its Apollo heritage. To become metaindustrial organizations, NASA and its aerospace partners will have to create a new work culture. For that purpose, the first step should be a survey and assessment of their contemporary organizational culture, so as to ascertain what changes are necessary for future space management. For NASA, the management changes involve new relationships with the military and private sector, as well as with international space consortia and possibly some new entities, such as a global space agency.

Autho

#### A87-38576

# INTERNATIONAL SAMPE TECHNICAL CONFERENCE, 18TH, SEATTLE, WA, OCT. 7-9, 1986, PROCEEDINGS

J. T. HOGGATT, ED., S. G. HILL, ED., and J. C. JOHNSON, ED. (Boeing Co., Seattle, WA) Conference sponsored by SAMPE.

Covina, CA, Society for the Advancement of Material and Process Engineering (International SAMPE Technical Conference Series. Volume 18), 1986, 1137 p. For individual items see A87-38577 to A87-38584, A87-38586 to A87-38643.

The present conference on advanced materials applicable to spacecraft structures and components discusses low distortion tooling for high precision space components, thermoplastic matrix composites, an industrial space facility, composite fabrication process automation, the fusion bonding of thermoplastic composites, failure-resistant bismaleimide/carbon composites, a solvent-resistant thermoplastic, the degradation of teflon in an oxidizing plasma, microgravity processing of zeolites in space, and joint technology for the Space Station truss structure. Also considered are space environment-induced microdamage, composite tubes for the Space Station truss structure, novel polyarylene ethers, composite space antenna structures, the thermal expansion behavior of graphite/glass adn graphite/magnesium, an atomic oxygen beam facility, encapsulants for electronic components, high temperature aromatic matrix systems, and materials issues associated with the Space Station.

#### A87-38579

## THE INDUSTRIAL SPACE FACILITY

MAXIME A. FAGET (Space Industries, Inc., Webster, TX) IN: International SAMPE Technical Conference, 18th, Seattle, WA, Oct. 7-9, 1986, Proceedings. Covina, CA, Society for the Advancement of Material and Process Engineering, 1986, p. 68-82.

The Industrial Space Facility (ISF) is a manned space platform designed to furnish access to microgravity environments characterized by minimum disturbances. Abundant electrical power, cooling capacity, and pressurized volume with which to support a variety of commercial and government uses will characterize the ISF, in which the operating astronauts will be able to work in 'shirt-sleeve' environmental conditions during servicing and resupply operations. The ISF facility will operate as an autonomous unmanned free-flier between Space Shuttle visits. Flight control and disturbance forces will be minimized through the use of an innovative gravity gradient stabilization and control system. O.C.

### A87-38723

## A MAINTENANCE WORK STATION FOR SPACE STATION

M. JUNGE (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) IN: Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986. Warrendale, PA, Society of Automotive Engineers, Inc., 1986, p. 207-213. (SAE PAPER 860933)

The 20-year life cycle of the NASA Space Station calls for the maintenance and repair of critical items in orbit. Attention is presently given to the Maintenance Work Station (MWS), which will be a centralized location for maintenance and repair activities that will contain all tools, equipment, and support functions. The MWS must be integrated into an overall Space Station data management subsystem incorporating direct communication with the inventory control management subsystem, and must exhibit human levels of decisionmaking expertise in order to enhance human operator productivity and reduce task times.

**A87-40068**\*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

## THE MECHANICS OF MANUFACTURING IN SPACE

D. C. WADE (NASA, Johnson Space Center, Houston, TX) IN: U.S. National Congress of Applied Mechanics, 10th, Austin, TX, June 16-20, 1986, Proceedings . New York, American Society of Mechanical Engineers, 1987, p. 305-308.

The history of the U.S. manned space-flight program is briefly reviewed, with an emphasis on the development of materials-processing technology, and space-manufacturing aspects of the Space Station and proposed lunar and Martian bases are discussed. Consideration is given to the Mercury, Gemini, Apollo, and Apollo-Soyuz missions; Space Shuttle materials-processing experiments; plans for processing electronics crystals, metals,

glasses and ceramics, biological materials, and fluids and chemicals on the Space Station; extraction of O2, Fe, Ni, and H2 from lunar materials for use as propellants and in space construction (e.g., of solar power satellites); and the requirements for a permanent base on Mars.

T.K.

#### A87-40286

# THE INDUSTRIAL USE OF SPACELAB [DIE INDUSTRIELLE SPACELAB-NUTZUNG]

HANS E. W. HOFFMANN (Hermann-Oberth-Gesellschaft; Intospace GmbH, Hannover, West Germany) (Hermann-Oberth-Gesellschaft, Raumfahrtkongress, 35th, Garmisch-Partenkirchen, West Germany, Oct. 2-4, 1986) Astronautik (ISSN 0004-6221), vol. 24, Jan.-Mar. 1987, p. 8, 9. In German.

Experiments aboard Spacelab that have industrial implications are discussed. The transition from Spacelab to a space station and the D1 Spacelab mission are addressed, stressing the role of the Space Shuttle in experiments with industrial applications. The role of the European user firm Intospace in these efforts is examined.

#### A87-41218

## RECONSTITUTING THE US SPACE PROGRAMME

JOHN M. LOGSDON (George Washington University, Washington, DC) Space Policy (ISSN 0265-9646), vol. 3, May 1987, p. 86-88.

Proposals to reconstitute the U.S. civilian space program are briefly discussed, with an emphasis on political and economic factors. The symbolic nature of the space program (as a way of demonstrating national power and technological competence) is found to be as important today as it was at the establishment of NASA in 1958 and at the inception of the Apollo program in 1961. It is argued that current NASA funding (about \$9 billion per year) is sufficient for a space program comprising projects carefully selected to fulfill these symbolic aims. The elements of such a program include renewal of the technology base to assure access to space for all purposes, appropriate use of the Space Shuttle, a significant role for humans in space, a perceived future for space science and exploration, and a Space Station with broad international participation.

#### A87-41222 PRIORITIES AND POLICY ANALYSIS - A RESPONSE TO ALEX ROLAND

JOHN M. LOGSDON Space Policy (ISSN 0265-9644), vol. 3, May 1987, p. 112-114.

This response to Alex Roland's article, 'Priorities in space for the USA' (1987), argues that his analysis and conclusions are based on shaky historical evidence. Professor Roland's interpretation of NASA's priorities since 1959 is challenged, and it is pointed out that the manned spaceflight program has widespread support in the U.S. The most important issue, raised by the article but not treated extensively enough, is whether the pursuit of the widely accepted emphasis on manned spaceflight is a large-scale societal mistake.

## A87-41568

# SPACE: NEW OPPORTUNITIES FOR ALL PEOPLE; SELECTED PROCEEDINGS OF THE THIRTY-SEVENTH INTERNATIONAL ASTRONAUTICAL CONGRESS, INNSBRUCK, AUSTRIA, OCT. 4-11, 1986

L. G. NAPOLITANO, ED. (Napoli, Universita, Naples, Italy) Congress sponsored by IAF. Acta Astronautica (ISSN 0094-5765), vol. 16, 1987, 402 p. For individual items see A87-41570 to A87-41575.

The present conference on astronautics considers the NASA Automation and Robotics Technology Program, the objectives and design of the Columbus system, a NASA Space Station development status assessment, international commonality for the Space Station, the Voyager Uranus mission, trends in space transportation, advanced space propulsion concepts, a model test vehicle for hypersonic aerospace system development, and satellite autonomous navigation employing Navsat. Also discussed are the

DORIS orbitography and positioning system, a quality assessment of SPOT 1 images, an evaluation of mobile satellite systems, mobile communications, navigation and surveillance, a closed Brayton solar dynamic power system for the Space Station, hydrocarbon rocket propulsion technology, and the Hermes shuttle thermal protection system.

**A87-41571\*** National Aeronautics and Space Administration, Washington, D.C.

## THE SPACE STATION OVERVIEW

JOHN D. HODGE and WILLIAM P. RANEY (NASA, Office of Space Station, Washington, DC) (IAF, International Astronautical Congress on Space: New Opportunities for all People, 37th, Innsbruck, Austria, Oct. 4-11, 1986) Acta Astronautica (ISSN 0094-5765), vol. 16, 1987, p. 55-62.

This paper is an overview of the Space Station status and activities being undertaken by NASA in cooperation with Canada, the European Space Agency and Japan. A review of the progress within the past year including user requirements, design baseline, operations concept and program planning is covered. Discussion of design decisions and recent changes in the management organization are highlighted. Of special importance is discussion of the Space Station utilization with focus on insuring that the design requirements are responsive to user needs and consistent with life cycle cost. A preliminary operations concept is explored, and options for evolving the Space Station identified.

#### A87-41572

## TRENDS IN SPACE TRANSPORTATION

R. F. BRODSKY (TRW, Inc., TRW Space and Technology Group, Redondo Beach, CA) and M. G. WOLFE (Aerospace Corp., Los Angeles, CA) (IAF, International Astronautical Congress on Space: New Opportunities for all People, 37th, Innsbruck, Austria, Oct. 4-11, 1986) Acta Astronautica (ISSN 0094-5765), vol. 16, 1987, p. 105-112.

An evaluation is made of emerging design trends in third-generation launch vehicle concepts being entertained in the U.S., Western Europe, and Soviet Union. Novel concepts encompass the horizontal-takeoff-and-landing SSTO, Space Shuttle-derived vehicles, and mammoth heavy lift vehicles. The projected performance capabilities and economic feasibility of these systems are compared. While civilian uses for these vehicles will encompass the extension of current communications and earth observation capabilities and the support of further planetary expeditions, military applications will be dominated by the requirements of the reconnaissance and communication tasks that will be included in the Strategic Defense Initiative system as well as by the constitution of a permanent weapons capability in space.

#### A87-42267#

# A MODEL FOR THE ESTIMATION OF THE OPERATIONS AND UTILISATION COSTS OF AN INTERNATIONAL SPACE STATION

A. P. FOURNIER-SICRE and R. P. ROGERS (ESA, European Space Research and Technology Centre, Noordwijk, Netherlands) ESA Journal (ISSN 0379-2285), vol. 10, no. 4, 1986, p. 373-380.

To estimate the operations and utilization costs of a subset of the elements of an international space station, certain cost-sharing rules must be developed regarding the common support facilities. To simulate the effect of these strategies, and those of other prime parameters (including transportation, communications, and levels of use of the space station facilities and crew) on the total running costs, a cost model has been developed, together with associated software. Both the methodology employed in the model, and the capabilities of the software are presented.

#### A87-44375

## SPACE THE NEXT TWENTY-FIVE YEARS

THOMAS R. MCDONOUGH (California Institute of Technology, Pasadena) New York, John Wiley and Sons, Inc., 1987, 250 p. refs

Prospects for the next 25 years of the U.S. space program

are considered. Technical advances that may lead to lunar bases, the development of the Strategic Defense Initiative, interstellar travel, the use of robots in space, space stations, and new SETI methods are examined. Possible scientific missions to study the inner planets, Mars, the asteroids and comets, the outer planets, and the universe are discussed.

#### A87-45476

# GLOBECOM '86 - GLOBAL TELECOMMUNICATIONS CONFERENCE, HOUSTON, TX, DEC. 1-4, 1986, CONFERENCE RECORD. VOLUMES 1, 2, & 3

Conference sponsored by IEEE. New York, Institute of Electrical and Electronics Engineers, Inc., 1986. Vol. 1, 664 p.; vol. 2, 619 p.; vol. 3, 660—p. For individual items see A87-45477 to A87-45559.

Papers are presented on local area networks; formal methods communication protocols; computer simulation communication systems; spread spectrum and communications: tropical radio propagation; communications; strategies for increasing software productivity; multiple access communications; advanced communication satellite technologies; and spread spectrum systems. Topics discussed include Space Station communication and tracking development transmission networks; modulation: communications; computer network protocols and performance; and coding and synchronization. Consideration is given to free space optical communications systems; VSAT communication networks; network topology design; advances in adaptive filtering echo cancellation and adaptive equalization; advanced signal processing for satellite communications; the elements, design, and analysis of fiber-optic networks; and advances in digital microwave systems.

A87-46332\* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

MAN'S ROLE IN SPACE EXPLORATION AND EXPLOITATION JOSEPH P. LOFTUS (NASA, Johnson Space Center, Houston, TX) Spaceflight (ISSN 0038-6340), vol. 29, June 1987, p. 240-247.

The crew workloads on the Space Shuttle are described. The Space Shuttle is designed to minimize the activity of the crew in maintaining and operating the Shuttle in order for the crew to be involved in productive activities. The changing role of the crew due to the use of more automated systems on spacecraft is examined. The Shuttle flight system is dependent on embedded software, and the crew is to manage and support these systems. The primary functions of the Space Station are as a laboratory and for construction and assembly of systems, requiring EVA. Examples of EVA are presented. The correlation between manned and unmanned systems and the future direction of space research are discussed.

#### A87-46875

## WE SHOULDN'T BUILD THE SPACE STATION NOW

ALEX ROLAND (Duke University, Durham, NC) Technology Review (ISSN 0040-1692), vol. 90, July 1987, p. 22, 23.

The present evaluation of the goals and resources of the U.S. space program notes that the construction of a Space Station enjoys only narrow support beyond NASA and the aerospace industry, in the scientific and engineering communities that would be expected to make the greatest use of it. In addition, it is argued that the first phase of Space Station construction will cost far in excess of the \$13 billion estimated in April 1987 and be completed significantly later that the 1996 date projected. The Space Station is further alleged to constitute a drain on NASA funds that will starve more productive programs concerned with space science experimentation, and invite more intensive military participation and funding, thereby further complicating the already problematic legal aspects of space use.

#### A87-46975

THE SPACE STATION: A PERSONAL JOURNEY

HANS MICHAEL MARK (Texas, University, Austin) Durham, NC, Duke University Press, 1987, 272 p.

An insider's account is given of space science policy and politics during two American presidencies that climaxed in the go-ahead for the Space Station program. The relevant technological debates are addressed in detail, including the effect of the Challenger tragedy. The development of the Shuttle and the relationship of the space program to arms control and other topics are also conssidered.

#### A87-47726

#### **SPACE STATION BUSINESS**

PETER GWYNNE High Technology (ISSN 0277-2981), vol. 7, Aug. 1987, p. 10-16.

The competition among aerospace companies for contracts to build the proposed U.S. Space Station is described. It is noted that November 1987 is the decisive time when NASA is expected to award 8-billion dollars worth of work. A chart is presented which lists the lead contractors who will compete for each segment and the major subcontractors working for them.

B.J.

#### A87-47868

## SPACE STATION - THE NEXT LOGICAL STEP

ANGELO GUASTAFERRO and MICHELLE A. FARRANCE (Lockheed Missiles and Space Co., Inc., Astronautics Div., Sunnyvale, CA) Lockheed Horizons (ISSN 0459-6773), Dec. 1986, p. 16-26.

The major objectives of the NASA Space Station are to provide an orbiting facility to be used for government, industrial, and academic scientific research, to serve as a base for servicing free-flying spacecraft in earth orbit, to furnish a platform for astronomical and remote-sensing earth observations, and to establish a site for the assembly of spacecraft in orbit. Attention is presently given to projected Space Station laboratory equipment, a health-maintenance facility, a habitability module, EVA systems, and such subsystems as those involved in the Space Station keel lattice structure, passive and active heat rejection, power generation, and mechanical elements.

A87-48594\*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

# STANDARDS FOR THE USER INTERFACE - DEVELOPING A USER CONSENSUS

KAREN L. MOE, DOROTHY C. PERKINS, and MARTHA R. SZCZUR (NASA, Goddard Space Flight Center, Greenbelt, MD) AIAA and NASA, International Symposium on Space Information Systems in the Space Station Era, Washington, DC, June 22, 23, 1987. 6 p. refs (AIAA PAPER 87-2209)

The user support environment (USE) which is a set of software tools for a flexible standard interactive user interface to the Space Station systems, platforms, and payloads is described in detail. Included in the USE concept are a user interface language, a run time environment and user interface management system, support tools, and standards for human interaction methods. The goals and challenges of the USE are discussed as well as a methodology based on prototype demonstrations for involving users in the process of validating the USE concepts. By prototyping the key concepts and salient features of the proposed user interface standards, the user's ability to respond is greatly enhanced. K.K.

#### A87-51869

# THE GAGARIN SCIENTIFIC LECTURES ON ASTRONAUTICS AND AVIATION, 1986 [GAGARINSKIE NAUCHNYE CHTENIIA PO KOSMONAVTIKE I AVIATSII, 1986 G.]

A. IU. ISHLINSKII, ED. Moscow, Izdatel'stvo Nauka, 1987, 264 p. In Russian. No individual items are abstracted in this volume.

Complete papers are presented on a review of 25 years of manned space flights, space industrialization, and the Vega project. The bulk of the present work contains abstracts of papers presented at the Lectures in such fields as flight mechanics, flight simulation, spacecraft control, spacecraft design and testing,

thermal and gasdynamic problems of space flight, spacecraft structural strength, and space manufacturing.

PERSPECTIVES ON MATERIALS PROCESSING IN SPACE

KURT P. JOHNSON (McDonnell Douglas Astronautics Co., Saint Louis, MO) IN: The human quest in space; Proceedings of the Twenty-fourth Goddard Memorial Symposium, Greenbelt, MD, Mar. 20, 21, 1986 . San Diego, CA, Univelt, Inc., 1987, p. 19-26; Discussion, p. 27.

(AAS PAPER 86-103)

The current status of materials processing in space (MPS) is examined. The advantages the space environment provides to materials processing, and a number of commercial applications for MPS are discussed. The factors which limit the amount of industry involvement in MPS programs are described, and examples of microgravity experiments, such as the continuous electrophoresis process development for separating pharmaceuticals and biologicals produced by advanced biotechnology and the organic polymers and crystals research program, are presented. Consideration is given to the role of the Space Shuttle and Space Station in MPS and the policies necessary to assure continued MPS R&D.

A87-53085

PROSPECTS FOR SPACE SCIENCE

CARL SAGAN (Cornell University, Ithaca, NY; Planetary Society, IN: The human quest in space; Proceedings of the Twenty-fourth Goddard Memorial Symposium, Greenbelt, MD, Mar. 20, 21, 1986 . San Diego, CA, Univelt, Inc., 1987, p. 45-51; Discussion, p. 52-55.

(AAS PAPER 86-106)

The use of the space environment for astronomy and the study of the earth is examined. Particular attention is given to the exploration of the electromagnetic spectrum and the solar system. It is argued that it is necessary to complete the proposed missions to rendezvous with a comet and to send an entry probe into the atmosphere of Titan. The need for the development of a Space Station is discussed, and the benefits of manned versus unmanned missions are considered. The political, social, and economic benefits of a joint U.S./Soviet manned mission to Mars are also LF. discussed.

A87-53924# COOPERATION BETWEEN EUROPE AND THE UNITED STATES IN SPACE (THE FULBRIGHT 40TH ANNIVERSARY

LECTURE)

R. LUEST (ESA, Paris, France) ESA Bulletin (ISSN 0376-4265),

no. 50, May 1987, p. 98-104.

The relationship between Europe and the U.S. in space projects is examined. The relationship can be divided into three periods: (1) tutorship of Europe by the U.S., (2) Europe as a junior partner of the U.S., and (3) partnership and competition between Europe and the U.S. The scientific and technical, economic, and political reasons for joint space projects between Europe and the U.S. are discussed. Cooperation between Europe and the U.S. for the development of the Space Station is considered. LF.

A87-53989

LEADERSHIP IN SPACE TRANSPORTATION

JOEL S. GREENBERG (Princeton Synergetics, Inc., NJ)

Policy (ISSN 0265-9646), vol. 3, Aug. 1987, p. 179, 180. The role of the U.S. government, through its civilian space

program, in promoting the competitiveness of U.S. marketers of commercial launch services (CLSs) is discussed. The need to concentrate R&D efforts and funding in specific areas (rather than aiming for overall preeminence in space) is indicated, and the competition faced by the U.S. CLS industry in the global market is briefly characterized. It is argued that U.S. CLS marketers would have a distinct advantage if they could offer customers access, on a contractual basis, to the unique on-orbit experimentation and maintenance/repair capabilities of the Space Shuttle and Space Station. It is recommended that long-term commercial and economic factors be given more weight when international cooperation agreements are negotiated.

N87-20311\*# Ohio State Univ., Columbus. Dept. of Aeronautical and Astronautical Engineering.

PROGRESS ON THE OHIO STATE UNIVERSITY GET AWAY SPECIAL G-0318: DEAP

NESRIN SARIGUL and A. J. MORTENSEN (Gould, Inc., Cleveland, In NASA. Goddard Space Flight Center The 1986 Get Away Special Experimenter's Symposium p 59-62 Feb. 1987 Avail: NTIS HC A11/MF A01 CSCL 22A

The Get Away Special program became a major presence at the Ohio State University with the award of GAS-0318 by the American Institute of Aeronautics and Astronautics. There are some twenty engineering researchers and students currently working on the project. GAS-0318 payload is an experimental manufacturing process known as Directional Electrostatic Accretion Process (DEAP). This high precision portable microgravity manufacturing method will revolutionize the manufacture and repair of spacecraft and space structures. The cost effectiveness of this process will be invaluable to future space development and exploration.

Author

N87-20632# European Space Agency, Paris (France). USA-EUROPE COORDINATION AND COOPERATION ACTIVITIES: ANNOUNCEMENTS OF OPPORTUNITY

G. DUCHOSSOIS In its Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-sensing (ESPOIR) p 69-71 Nov. 1986 Avail: NTIS HC A07/MF A01

International Space Station polar platform Announcements of Opportunity objectives, content, schedule, evaluation and selection process, address, funding sources, data access and rights, as discussed and agreed within the Coordination Group are outlined.

N87-20667\*# Rockwell International Corp., Canoga Park, Calif.

Rocketdyne International DENSITY UNCERTAINTY EFFECT ON COST OF SPACE STATION REBOOST Abstract Only

WALTER UNTERBERG and CLAUS MEISL In NASA. Marshall Space Flight Center Upper and Middle Atmospheric Density Modeling Requirements for Spacecraft Design and Operations p Feb. 1987

Avail: NTIS HC A13/MF A01 CSCL 22B

If the space station is designed for operation in a nominal atmosphere for ten years and the atmosphere is two-sigma higher than nominal during the entire ten year period, the impact would be an additional cost of \$70.1 million, based on a resupply cost of \$3200/lb. A cost analysis of the space station fuel consumption with reboost is presented.

Air Force Inst. of Tech., Wright-Patterson AFB, N87-21753# Ohio.

PRESENT AND FUTURE MILITARY USES OF OUTER SPACE: INTERNATIONAL LAW, POLITICS, AND THE PRACTICE OF STATES M.S. Thesis

DONALD E. WALSH Aug. 1986 211 p (AD-A176722; AFIT/CI/NR-87-19T) Avail: NTIS HC A10/MF

A01 CSCL 15C

This thesis examines the present and future military uses of outer space with an emphasis on the policies and practices of international states. These policies and practices are examined in the context of the emergence of international space law. The thesis proceeds from an examination of the early years of the space age and move to an examination of the present and future military uses of outer space. Next is given a review of international treaties affecting military activities in outer space. The law is then applied to the present and future activities examined above, with prospects for the future.

N87-21754# Office of Technology Assessment, Washington,

SPACE STATIONS AND THE LAW: SELECTED LEGAL ISSUES Sep. 1986 88 p

(PB87-118220; OTA-BP-ISC-41; LC-86-600569) Avail: NTIS HC A05/MF A01 CSCL 05D

Part 1 is a background paper which discusses the legal consequences of developing and operating the space station. This paper examines the different ways in which a multinational space station might be owned and operated and explains how each could affect the rights and responsibilities of the U.S. Government and its citizens. In addition, it gives special attention to the application of jurisdiction, tort law, intellectual property, and criminal law to nations and individuals living and working in space. Part 2 of this report is a summary of the workshop held by OTA to critique and expand on the initial drafts of Part 1.

#### N87-22560# Committee on Appropriations (U.S. House). DEPARTMENT OF HOUSING AND URBAN **DEVELOPMENT-INDEPENDENT AGENCIES APPROPRIATIONS FOR 1988**

Washington 1031 p 1987 Hearings before the Subcommittee on HUD-Independent Agencies of the Committee on Appropriations, 100th Congress, 1st Session, 7 Apr. 1987 (GPO-73-418) Avail: Subcommittee on HUD-Independent

The Federal Budget requests by the National Aeronautics and Space Administration for the Fiscal Year 1988 are discussed. These requests cover the expenditure for returning the Shuttle to flight status; commitments to the space station; space science and applications; space research and technology; space tracking and data systems; institutional programs; and construction and maintenance.

## N87-22697# Lawrence Livermore National Lab., Calif. TOWARD THE YEAR 2000: THE NEAR FUTURE OF THE

AMERICAN CIVILIAN AND MILITARY SPACE PROGRAMS
L. L. WOOD and M. Y. ISHIKAWA Jan. 1987 10 p Presented at the 3rd National Space Symposium of the US Space Foundation, Colorado Springs, Colo., 20 Jan. 1987 (Contract W-7405-ENG-48)

(DE87-006467; UCRL-96258; CONF-870162-1) Avail: NTIS HC A02/MF A01

The basic features of the American civilian and military space programs at the end of this century are identified and their histories traced back to the present time, for the surprise-free scenario. Several of the more likely surprises are noted, and their probable impacts sketched.

#### N87-24240# Committee on Commerce, Science, and Transportation (U.S. Senate). NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Washington GPO 1987 47 p A bill, S. 1164, referred to the Committee on Commerce, Science and Transportation, 100th Congress, 1st Session, 7 May 1987

(S-REPT-100-87) Avail: US Capitol, Senate Document Room

Appropriations for the National Aeronautics and Space Administration for research and development, space flight, control and data communication, construction of facilities, and research and program management are discussed. BG

N87-24496\*# National Aeronautics and Space Administration, Washington, D.C.

SPACE STATION: A PROGRAM OVERVIEW

**AUTHORIZATION ACT** 

JUDITH H. AMBRUS In NASA-Langley Research Center NASA/DOD Control/Structures Interaction Technology, 1986 p. 579-590 Jun. 1987

Avail: NTIS HC A14/MF A01 CSCL 22B

An overview is presented of the NASA program for the development of the Space Station. A general representation of the initial Space Station complex is shown. The Space Station

goals and program objectives are briefly reviewed, as well as the program schedule. An advanced development program and program management approach are also presented.

N87-25024# Committee on Science, Space and Technology (U.S. House).

### NATIONAL AERONAUTICS AND SPACE ADMINISTRATION **AUTHORIZATION ACT, FISCAL YEAR 1988**

GPO 1987 270 p Washington Report on H.R. 2782 presented by the Committee on Science, Space and Technology to the Committee of the Whole House on the State of the Union, 100th Congress, 1st Session, 7 Jul. 1987

(H-REPT-100-204; GPO-69-356) Avail: NTIS HC A12/MF A01

Appropriations to the National Aeronautics and Space Administration (NASA) are reviewed for research and development; space flight, control, and data communications; construction of facilities, and research and development management.

#### N87-25354# European Space Agency, Paris (France). PROCEEDINGS OF THE SECOND INTERNATIONAL SYMPOSIUM ON SPACECRAFT FLIGHT DYNAMICS

T. D. GUYENNE, comp. and J. J. HUNT, comp. Symposium held in Darmstadt, West Germany, 20-23 Oct. 1986

(ESA-SP-255; ISSN-079-6566; ETN-87-99862) Avail: NTIS HC A22/MF A01

Flexible spacecraft dynamics; halo orbits; interplanetary trajectories; geostationary satellites; precise orbit determination; onboard systems and spacecraft hardware; orbital mechanics; spinning spacecraft; satellite tracking; and ground systems were discussed.

**FSA** 

N87-25760\*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

#### WORKSHOP ON WORKLOAD AND TRAINING, AND **EXAMINATION OF THEIR INTERACTIONS: EXECUTIVE** SUMMARY

EMANUEL DONCHIN (Illinois Univ., Urbana-Champaign.), SANDRA G. HART, and EARL J. HARTZELL Jul. 1987 40 p Workshop held in Carmel, Calif., 5-10 Jan. 1986

(NASA-TM-89459; A-87212; NAS 1.15:89459) Avail: NTIS HC A03/MF A01 CSCL 05H

The goal of the workshop was to bring together experts in the fields of workload and training and representatives from the Dept. of Defense and industrial organizations who are reponsible for specifying, building, and managing advanced, complex systems. The challenging environments and requirements imposed by military helicopter missions and space station operations were presented as the focus for the panel discussions. The workshop permitted a detailed examination of the theoretical foundations of the fields of training and workload, as well as their practical applications. Furthermore, it created a forum where government, industry, and academic experts were able to examine each other's concepts, values, and goals. The discussions pointed out the necessity for a more efficient and effective flow of information among the groups respresented. The executive summary describes the rationale of the meeting, summarizes the primary points of discussion, and lists the participants and some of their summary comments.

## N87-25815# Air Command and Staff Coll., Maxwell AFB, Ala. MILITARY MAN IN SPACE: A HISTORY OF AIR FORCE EFFORTS TO FIND A MANNED SPACE MISSION Student **Report, 1945 - 1987** TIMOTHY D. KILLEBREW Feb. 1987 77 p

(AD-A179873; ACSC-87-1425) Avail: NTIS HC A05/MF A01 CSCL 12B

This report traces the Air Force's efforts to find a manned military space role. It begins with the development of Dyna Soar shortly after World War II. The author traces Dyna Soar's evolution and political problems that caused its eventual cancellation and discusses the Manned Orbiting Laboratory from its beginnings in

1963 until its cancellation in 1969. He also gives the potential uses of the Manned Orbiting Laboratory and the reasons behind its cancellation. The beginnings of the Space Transportation System and the reasons behind the Air Force's decision to use STS as the sole means of entering space are traced. The study concludes with a short discussion on the future of Air Force manned space efforts including a follow-on to the Space Shuttle and the probability of a space station.

N87-26964# Army War Coll., Carlisle Barracks, Pa.
MILITARY SPACE STATION IMPLICATIONS
GARRETT D. BOURNE, GLEN D. SKIRVIN, and GERALD R.

GARRETT D. BOURNE, GLEN D. SKIHVIN, and GEHALD N WILSON 23 Mar. 1987 186 p

(AD-A180831) Avail: NTIS HC A09/MF A01 CSCL 22B The relevancy of a Manned Military Space Station (MMSS) and its deployment to capitalize on the United States' national security interests is the purpose of this report. The MMSS is intended to perform a two-fold purpose: (1) facilitate military peacetime operations while simultaneously supporting and promoting civilian space initiatives; and, (2) act as a force multiplier for space and terrestrial force operations in the event of conventional, theater nuclear, and/or strategic nuclear war. Data to support the future value of the MMSS was obtained from individual and group research using unclassified sources such as professional journals, books, US Air Force Staff College reference material, and information from the US Air Force space coordinating staff in Washington, D.C. The importance of space to our future and especially of a MMSS by America's national leaders and its people has yet to be fully appreciated and/or realized. The significance of space and its nexus to the United States' national security has been growing in importance since Sputnik in 1957. Space cannot and should not be understated in importance as it relates to commerce, war deterrence, and to the stability of world

N87-29155\*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

TESTING AND ANALYSIS OF DOD ADA LANGUAGE PRODUCTS FOR NASA

In NASA, Washington, Proceedings: Computer Science and Data Systems Technical Symposium, Volume 2 20 p Aug. 1985 Avail: NTIS HC A17/MF A01 CSCL 09B

An activity is described that is keyed to Johnson Space Center's role as an Ada/APSE test site. Specific objectives and concerns relative to potential utilization of Ada for the Space Station are discussed. Finally, detailed discussion is provided concerning study tasks soon to be contracted out for detailed investigation and project risk assessment.

N87-30220# Committee on Appropriations (U.S. Senate).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
In its Department of Housing and Urban Development - Independent
Agencies Appropriation Bill, 1988 p 64-73 6 Oct. 1987
Avail: NTIS HC A06/MF A01

The objectives of the NASA program of research and development are to extend the knowledge of the Earth, its space environment, and the universe; to expand the practical applications of space technology; to develop, operate, and improve unmanned space vehicles; to provide technology for improving the performance of aeronautical vehicles while minimizing the environmental effects and energy consumption; and to assure continued development of the aeronautics and space technology necessary to accomplish national goals. The appropriations necessary to accomplish these goals are examined.

N87-30221# Committee on Commerce, Science, and Transportation (U.S. Senate).

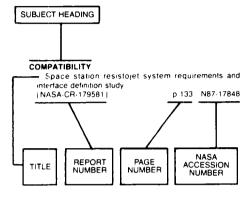
NASA AUTHORIZATION: AUTHORIZATION OF APPROPRIATIONS FOR THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION FOR FISCAL YEAR 1988

Washington GPO 1987 471 p Hearings on S-Hrg-100-231 before the Subcommittee on Science, Technology and Space of

the Committee on Commerce, Science and Transportation, 100th Congress, 1st Session, 3, 19, 26 Feb.; 5 Mar. and 29 Apr. 1987 (GPO-73-245) Avail: NTIS HC A20/MF A01

Appropriations for the FY88 budget for NASA are examined. Prioritization of the four upcoming planetary missions-Galileo, Ulysses, Magellan, and the Mars Observer is discussed. Obstacles which delay the return of the shuttles to service and which delay the building of the space station are also discussed. B.G.

### Typical Subject Index Listing



The subject heading is a key to the subject content of the document. The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of the document content, the title extension is added, separated from the title by three hyphens. The (NASA or AIAA) accession number and the page number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identify the document. Under any one subject heading, the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

#### **ABSORPTANCE**

Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit Correlation of flight data and laboratory p 144 A87-32346 measurements

#### **AC GENERATORS**

Permanent-magnet linear alternators, I - Fundamental equations. II - Design guidelines p 76 A87-39735 Resistojet control and power for high frequency ac

[AIAA PAPER 87-0994]

p 58 A87-41103

Resistojet control and power for high frequency ac p 63 N87-20477

[NASA-TM-89860] ACCELERATION (PHYSICS)

Crew activity and motion effects on the space station p 165 N87-22744 Analytical determination of space station response to

crew motion and design of suspension p 67 N87-22752 microgravity experiments Optimal shuttle altitude changes using tethers

p 129 N87-22756 [AD-A179205]

#### ACCESS CONTROL

Proof that timing requirements of the FDDI token ring protocol are satisfied --- fiber distributed data interface p 112 A87-42821

#### **ACCIDENTS**

Hyperbaric oxygen therapy for decompression accidents ential applications to Space Station Operation p 163 A87-38717 (SAF PAPER 8609271

**ACCUMULATORS** 

An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784

#### ACCURACY

Practical implementation of an accurate method for multilevel design sensitivity analysis [AIAA PAPER 87-0718] p 6 A87-33560

#### **ACOUSTIC EMISSION**

Space station integrated wall design and penetration damage control. Task 4: Impact detection/location system

[NASA-CR-179167]

n 4 N87-28583

#### **ACOUSTIC FREQUENCIES**

Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334

#### **ACOUSTIC PROPAGATION**

Vibrations and structureborne noise in space station [NASA-CR-181381] p 39 N87-29590 ACOUSTICS

Acoustic effects on the dynamic of lightweight p 28 N87-20372 structures ACTIVE CONTROL

Two-time-scale design of robust controllers for large p 12 A87-32443 structure systems d control/structure design and robustness [SAF PAPER 861821] n 6 A87-32657

Vibration suppression using a constrained rate-feedback Threshold control strategy --- for large space structures TAIAA PAPER 87-07411 n 6 A87-33665

Spillover stabilization and decentralized modal control

[AIAA PAPER 87-0903] n 17 A87-33712 A comparison of active vibration control techniques -Output feedback vs optimal control

[AIAA PAPER 87-09041 n 56 A87-33713 On a balanced passive damping and active vibration uppression of large space structures

[AIAA PAPER 87-09011 n 19 A87-34701 System aspects of Columbus thermal control p 150 A87-38727 (SAE PAPER 860938)

Actuators for actively controlled space structures

p 59 A87-42816 Soft mounted momentum compensated pointing system p 59 A87-42817 for the Space Shuttle Orbiter Space station active thermal control system modelling p 43 A87-43003 [AIAA PAPER 87-1468]

Active vibration control of a simply supported beam using n 23 A87-50232 spatially distributed actuator Active damping control design for the COFS Mast Flight System --- Control of Flexible Structures program for

[AIAA PAPER 87-2321] p 23 A87-50442 Active vibration control synthesis for the COFS-I - A classical approach --- Control of Flexible Structures

experiment for NASA

[AIAA PAPER 87-2322] An analytical and experimental investigation of output feedback vs. linear quadratic regulator --- for large space

structures [AIAA PAPER 87-2390] p 61 A87-50474

A new concept of generalized structural filtering for active vibration control synthesis

[AIAA PAPER 87-2456] p 24 A87-50502 structural controllers emulating Active p 27 N87-20367 elements by ICUs Air Force basic research in dynamics and control of

p 63 N87-20577 large space structures Microprocessor controlled proof-mass actuator n 65 N87-22706

Optimum mix of passive and active control of space p 65 N87-22714 Structural/control interaction (payload pointing and

p 9 N87-22721 micro-g) Workshop on Structural Dynamics and Control Flexible Structures p 32 N87-22728 Interaction of Elevible Structures Vibration suppression by stiffness control

p 66 N87-22730

Modified independent modal space control method for active control of flexible systems p 34 N87-23980 [NASA-CR-181065]

Joint Optics Structures Experiment (JOSE)

p 34 N87-24497 Spectral factorization and homogenization methods for

modeling and control of flexible structures p 35 N87-24517 [AD-A179726] Distributed control using linear momentum exchange

[NASA-TM-100308] p 70 N87-24521

Characterization and hardware modification of linear momentum exchange devices

n 70 N87-24723 [NASA-TM-86594] Active vibration damping of flexible structures using the p 71 N87-25360 traveling wave approach

A comparison between IMSC. Pl and MIMSC methods in controlling the vibration of flexible systems

p 36 N87-25605 [NASA-CR-181156] Development of intelligent structures using finite control

elements in a hierarchic and distributed control system [AD-A179711] p 72 N87-25805 Joint nonlinearity effects in the design of a flexible truss

structure control system (NASA-CR-1806331 p 37 N87-26365

Vibration control of flexible structures using piezoelectric p 37 N87-26387 devices as sensors and actuators Active vibration control in microgravity environment n 72 N87-26700

performance of a Effect of bonding on the iezoactuator-based active control system

p 74 N87-29713 NASA-CR-1814141 ACTUATORS

A preliminary study on a linear inertial actuator for LSS control p 55 A87-32447

Control of flexible solar arrays with consideration of the actuator dynamics of the reaction wheel n 55 A87-32448

Study of actuator for large space manipulator arm p 12 A87-32545

Evaluation testing of a mechanical actuator component operating in a simulated space environment

A87-32549

The Mast Flight System dynamic characteristics and actuator/sensor selection and location [AAS PAPER 86-003] p 13 A87-32729

On the control of flexible structures by applied thermal gradients

[AIAA PAPER 87-0887] p 16 A87-33706 Optimal vibration control by the use of piezoceramic sensors and actuators

[AIAA PAPER 87-0959] p 18 A87-33751 Development of harmonic drive actuator for space p 149 A87-35076 manipulator A study on singularity of single gimbal CMG systems

p 149 A87-35077

Actuators for actively controlled space structures p 59 A87-42816

Flexible system model reduction and control system design based upon actuator and sensor influence A87-46301 p 59 functions

Active vibration control of a simply supported beam using p 23 A87-50232 a spatially distributed actuator Suboptimal feedback vibration control of a beam with proof-mass actuator large space structures

p 23 A87-50444 [AIAA PAPER 87-2323] Active structural controllers emulating structural p 27 N87-20367 elements by ICUs Multi-axis vibration tests on spacecraft using hydraulic

p 8 N87-20373 exciters Microprocessor controlled proof-mass actuator p 65 N87-22706

On the control of structures by applied thermal p 33 N87-22747 Modified independent modal space control method for active control of flexible systems

[NASA-CR-181065] p 34 N87-23980 Vibration control of flexible structures using piezoelectric evices as sensors and actuators p 37 N87-26387 devices as sensors and actuators An investigation of methodology for the control and failure identification of flexible structures

p 38 N87-26921 The 21st Aerospace Mechanisms Symposium p 103 N87-29858 (NASA-CP-2470) p 104 N87-29869 Common drive unit An electromechanical attenuator/actuator for Space p 138 N87-29878 Station docking

Optimum shape control of piezo-electric actuators flexible beams by p 40 N87-29898 NASA-CR-181413]

ADA (PROGRAMMING LANGUAGE)

Testing and analysis of DOD Ada language products for NASA p 172 N87-29155

# ADAPTIVE CONTROL

ADADEWS CONTROL	AEROMANEUVERING	AEROSPACE INDUSTRY
ADAPTIVE CONTROL  Adaptive planar truss structures and their vibration	Synergetic plane-change capability of a conceptual	Computerized aerospace materials data; Proceedings
characteristics	aeromaneuvering-orbital-transfer vehicle	of the Workshop on Computerized Property Materials and Design Data for the Aerospace Industry, El Segundo, CA,
[AIAA PAPER 87-0743] p 148 A87-33667	[AIAA PAPER 87-2565] p 92 A87-49615	June 23-25, 1986 p 111 A87-35282
Adaptive tracking of dynamical model by uncertain	Combining space-based propulsive maneuvers and aerodynamic maneuvers to achieve optimal orbital	AEROSPACE MEDICINE
nonlinearizable spacecraft [AIAA PAPER 87-0940] p 57 A87-33738	transfer	Space Station - Opportunities for the life sciences
An overview of controls research on the NASA Langley	[AIAA PAPER 87-2567] p 93 A87-49617	p 122 A87-34871
Research Center grid p 66 N87-22720	SAFE/DAE: Modal test in space p 77 N87-20584	When the doctor is 200 miles away
Moving-bank multiple model adaptive estimation applied	Singular perturbation analysis of AOTV related trajectory	Radiation environments and absorbed dose estimations
to flexible spacestructure control [AD-A178870] p 68 N87-22761	optimization problems [NASA-CR-180301] p 137 N87-26927	on manned space missions p 139 A87-49026
Control technology overview in CSI	Optimal nodal transfer and aeroassisted transfer by	Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030
p 69 N87-24507	aerocruise p 138 N87-28577	approaches to their mitigation p 154 A87-49030 Space biology and medicine on the twenty-fifth
ADAPTIVE FILTERS	AERONAUTICS  The Gagarin scientific lectures in astronautics and	anniversary of the first spaceflight of Yuriy Alekseyevich
Adaptive identification of flexible structures by lattice	aviation. 1985 Russian book p 152 A87-42923	Gagarin p 157 N87-20732
filters [AIAA PAPER 87-2458] p 24 A87-50504	The Gagarin Scientific Lectures on Astronautics and	An analysis of space station motion subject to the
ADHESIVE BONDING	Aviation, 1986 Book p 169 A87-51869	parametric excitation of periodic elevator motion [AD-A179235] p 68 N87-23681
Joint technology for graphite epoxy space structures	AEROSPACE ENGINEERING	AEROSPACE PLANES
p 20 A87-38600 Space environmental effects on adhesives for the	Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987, Technical	Physiological requirements and pressure control of a
Galileo spacecraft p 139 A87-38643	Papers, Part 1 p 13 A87-33551	spaceplane
AEROACOUSTICS	Structures, Structural Dynamics and Materials	[SAE PAPER 860965] p 150 A87-38747 The Soviet space shuttle programme
Documentation of the space station/aircraft acoustic	Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA	p 153 A87-47302
apparatus (NASA-TM-89111) p 140 N87-20795	Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Parts 2A & 2B	AEROSPACE SAFETY
[NASA-TM-89111] p 140 N87-20795 AEROASSIST	p 15 A87-33654	Safety on the Space Station p 162 A87-35599
Optimal trajectories for aeroassisted, coplanar orbital	A modern approach for modal testing using multiple input	AEROSPACE SCIENCES  K.E. Tsiolkovskii and problems in the development of
transfer p 54 A87-31681	sine excitation	science and technology Russian book
Aeroassist flight experiment guidance, navigation and	[AIAA PAPER 87-0964] p 19 A87-33754 An advanced technology space station for the year 2025,	p 151 A87-40342
control [AAS PAPER 86-042] p 133 A87-32744	study and concepts	The human quest in space; Proceedings of the
Design parameters and environmental considerations	[NASA-CR-178208] p 120 N87-20340	Twenty-fourth Goddard Memorial Symposium, Greenbelt, MD, Mar. 20, 21, 1986 p 2 A87-53082
for a reusable aeroassisted orbital transfer vehicle	USSR Report: Space	Prospects for space science
[AIAA PAPER 87-1505] p 160 A87-43031	[JPRS-USP-86-004] p 158 N87-27687 AEROSPACE ENVIRONMENTS	[AAS PAPER 86-106] p 170 A87-53085
Optimal heading change with minimum energy loss for a hypersonic gliding vehicle	Development of graphite epoxy space structure	AEROSPACE SYSTEMS
[AIAA PAPER 87-2568] p 136 A87-49618	p 105 A87-32342	Control operations in advanced aerospace systems p 54 A87-32117
Aeroassisted orbital maneuvering using Lyapunov	Assessment of space environment induced	Aerospace environmental systems; Proceedings of the
optimal feedback control	microdamage in toughened composite materials p 20 A87-38609	Sixteenth Intersociety Conference on Environmental
[AIAA PAPER 87-2464] p 93 A87-50509	Modeling of environmentally induced transients within	Systems, San Diego, CA, July 14-16, 1986 [SAF P-177] p 162 A87-38701
Aero-Assisted Orbital Transfer Vehicle (AOTV) p 3 N87-20682	satellites	[SAE P-177] p 162 A87-38701 Structure and design of spacecraft Russian book
System technology analysis of aeroassisted orbital	[AIAA PAPER 85-0387] p 7 A87-41611	p 155 A87-51870
transfer vehicles. Moderate lift/drag (0.75-1.5). Volume 1A,	Liquid droplet radiator development status waste heat rejection devices for future space vehicles	Technology projections and space systems
part 1: Executive summary, phase 1	[AIAA PAPER 87-1537] p 43 A87-43059	opportunities for the 2000-2030 time period
[NASA-CR-179139] p 97 N87-26062	Hydrogen-oxygen thruster with no products of	[AAS PAPER 86-109] p 2 A87-53086
System technology analysis of aeroassisted orbital transfer vehicles. Moderate lift/drag (0.75-1.5): Volume 1A,	combustion in exhaust plume [AIAA PAPER 87-1775] p 91 A87-45196	Spacecraft environment interaction investigation [AD-A179183] p 140 N87-23678
part 2: Executive summary, phase 2	[AIAA PAPER 87-1775] p 91 A87-45196 Taylored laminates with null or arbitrary coefficient of	[AD-A179183] p 140 N87-23678 AEROTHERMODYNAMICS
[NASA-CR-179140] p 3 N87-26063	thermal expansion p 107 A87-51794	The tethered satellite system for low density
System technology analysis of aeroassisted orbital	Gas tungsten arc welding in a microgravity environment:	aerothermodynamics studies p 127 A87-52450
transfer vehicles: Moderate lift/drag (0.75-1.5). Volume 3: Cost estimates and work breakdown structure/dictionary.	Work done on GAS payload G-169 p 136 N87-20306	System technology analysis of aeroassisted orbital
cost estimates and work breakdown structure/ dictionary, phase 1 and 2	The growth and harvesting of algae in a micro-gravity environment p 165 N87-20325	transfer vehicles: Moderate lift/drag (0.75-1.5),volume 1B,
[NASA-CR-179144] p 3 N87-26064	Liquid droplet radiator development status	part 1, study results [NASA-CR-179141] p 4 N87-26066
System technology analysis of aeroassisted orbital	[NASA-TM-89852] p 44 N87-20353	AGING (MATERIALS)
transfer vehicles: Moderate lift/drag (0.75-1.5). Volume 2:	Initial investigations into the damping characteristics of	Space environmental effects on adhesives for the
Supporting research and technology report, phase 1 and	wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569	Galileo spacecraft p 139 A87-38643
[NASA-CR-179143] p 3 N87-26065	[NASA-CR-180698] p 28 N87-20569 Upper and Middle Atmospheric Density Modeling	AIR
System technology analysis of aeroassisted orbital	Requirements for Spacecraft Design and Operations	Acoustic effects on the dynamic of lightweight structures p 28 N87-20372
transfer vehicles: Moderate lift/drag (0.75-1.5),volume 1B,	[NASA-CP-2460] p 64 N87-20665	AIR CONDITIONING
part 1, study results INASA-CR-1791411 p 4 N87-26066	Microgravity Fluid Management Symposium [NASA-CP-2465] p 94 N87-21141	An evolutionary approach to the development of a
	Advanced long term cryogenic storage systems	CELSS based air revitalization system
System technology analysis of aeroassisted orbital transfer vehicles: Moderate lift/drag (0.75-1.5), Volume 1B,	p 94 N87-21142	[SAE PAPER 860968] p 49 A87-38750
part 2, study results	Mixing-induced fluid destratification and ullage	AIR FLOW Vapor fragrancer
[NASA-CR-179142] p 4 N87-26067	condensation p 95 N87-21149 Superfluid helium on orbit transfer (SHOOT)	[NASA-CASE-LAR-13680-1] p 165 N87-25561
Singular perturbation analysis of AOTV related trajectory	p 95 N87-21151	AIR LAW
optimization problems [NASA-CR-180301] p 137 N87-26927	Microgravity fluid management in two-phase thermal	Present and future military uses of outer space:
Optimal nodal transfer and aeroassisted transfer by	systems p 95 N87-21152	International law, politics, and the practice of states  [AD-A176722] p 170 N87-21753
aerocruise p 138 N87-28577	Microgravity fluid management requirements of	[,,,,,
AEROBRAKING	advanced solar dynamic power systems p 77 N87-21153	AIR LOCKS  A multiple attribute decision analysis of manned airlock
Aeroassist flight experiment guidance, navigation and	Two-phase reduced gravity experiments for a space	systems
control LAAS PAPER 86-0421 p 133 A87-32744	reactor design p 8 N87-21154	[AD-A179241] p 137 N87-23682
[AAS PAPER 86-042] p 133 A87-32744  Aero-Assisted Orbital Transfer Vehicle (AOTV)	Soviet space stations as analogs, second edition (NASA-CR-180920) p 157 N87-21996	AIR NAVIGATION
p 3 N87-20682	[NASA-CR-180920] p 157 N87-21996 Spacecraft environment interaction investigation	AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers.
AERODYNAMIC CONFIGURATIONS	[AD-A179183] p 140 N87-23678	Volumes 1 & 2 p 60 A87-50401
System technology analysis of aeroassisted orbital	Ideas for educational physics experiments in space	AIR PURIFICATION
transfer vehicles: Moderate lift/drag (0.75-1.5),volume 1B,	p 130 N87-25033	Integrated air revitalization system for Space Station
part 1, study results [NASA-CR-179141] p 4 N87-26066	Contamination assessment for OSSA space station IOC payloads	[SAE PAPER 860946] p 48 A87-38733
[NASA-CR-179141] p 4 N87-26066 AEROELASTICITY	[NASA-CR-4091] p 53 N87-26086	Space Station life support oxygen generation by SPE
Interdisciplinary analysis procedures in the modeling and	Prayda commentary, photos of Mir orbital station	water electrolyzer systems [SAE PAPER 860949] p 49 A87-38736
control of large space-based structures	p 158 N87-27688	Hydrogen/oxygen economy for the space station
p 22 A87-42678	Space stable thermal control coatings [AD-A182796] p 110 N87-28584	p 98 N87-26130
Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and	[AD-A182796] p 110 N87-28584 Automated Subsystem Control for Life Support System	AIR QUALITY
large flexible structures	(ASCLSS)	Vapor fragrancer [NASA-CASE-LAR-13680-1] p 165 N87-25561
[AD-A183302] p 11 N87-29893	[NASA-CR-172003] p 53 N87-29117	[NASA-CASE-LAR-13680-1] p 165 N87-25561

AIR TO AIR REFUELING	ALKALINE BATTERIES	ANTIMATTER
An analysis of bipropellant neutralization for spacecraft refueling operations p 97 N87-25888	Advanced technology for extended endurance alkaline	Advanced propulsion activities in the USA
retueling operations p 97 N87-25888  AIR WATER INTERACTIONS	fuel cells p 75 A87-33787  Development of an alkaline fuel cell subsystem	p 90 A87-41575
An advanced wind scatterometer for the Columbus Polar	[NASA-CR-172002] p 81 N87-28188	APPLICATIONS PROGRAMS (COMPUTERS)  Thermodynamic analysis and subscale modeling of
Platform payload p 155 A87-53117  AIRBORNE/SPACEBORNE COMPUTERS	ALTERNATING CURRENT 20 kHz Space Station power system	space-based orbit transfer vehicle cryogenic propellant
Expert systems in space p 111 A87-32075	p 76 A87-40378	resupply [AIAA PAPER 87-1764] p 92 A87-48572
An evaluation of menu systems for Space Station	ALUMINUM Comparison of potellite support structure in	A TREETOPS simulation of the Hubble Space
interfaces p 111 A87-33040 Data capture and processing for Space Station	Comparison of satellite support structure aluminum versus graphite epoxy	Telescope-High Gain Antenna interaction
[AIAA PAPER 87-2203] p 113 A87-48588	[SAWE PAPER 1692] p 20 A87-36279	p 9 N87-22735 High speed simulation of flexible multibody dynamics
ESA software engineering standards for future	ALUMINUM ALLOYS  Material damping in aluminum and metal matrix	p 33 N87-22738
programmes [AIAA PAPER 87-2207] p 154 A87-48592	composites p 106 A87-49797	Thermodynamic analysis and subscale modeling of
Standards for the user interface - Developing a user	ALUMINUM COATINGS  Microcrack resistant structural composite tubes for	space-based orbit transfer vehicle cryogenic propellant resupply
consensus for Space Station Information System	space applications p 106 A87-41022	[NASA-TM-89921] p 96 N87-22949
[AIAA PAPEH 87-2209] p 169 A87-48594 The hardware/software architecture of the Columbus	ALUMINUM GRAPHITE COMPOSITES	TAE Plus: A conceptual view of TAE in the space station era p. 9 N87-23157
pressurized module element	Composite fiber/metal Space Station tankage - Applications, material/process/design trades, and	era p 9 N87-23157 SOT: A rapid prototype using TAE windows
[AIAA PAPER 87-2211] p 154 A87-48596	subscale manufacturing/test results	p 114 N87-23161
Evolution of data management systems from Spacelab to Columbus	[AIAA PAPER 87-2157] p 160 A87-45441 Development of metal matrix composites in R & D	Development of an emulation-simulation thermal control model for space station application
[AIAA PAPER 87-2227] p 154 A87-48605	Institute of Metals & Composites for Future Industries	[NASA-CR-180312] p 45 N87-26936
Flight array processor p 116 N87-29148	p 107 A87-51772	Substructure analysis using NICE/SPAR and
Fiber optics wavelength division multiplexing(components) p 117 N87-29151	Development of carbon dioxide removal system -	applications of force to linear and nonlinear structures spacecraft masts
AIRCRAFT CONSTRUCTION MATERIALS	Experimental study of solid amines p 145 A87-32456  AMMONIA	[NASA-CR-180317] p 38 N87-27260
Computerized aerospace materials data; Proceedings	Development of a water recovery subsystem based on	Development of an emulation-simulation thermal control
of the Workshop on Computerized Property Materials and Design Data for the Aerospace Industry, El Segundo, CA,	Vapor Phase Catalytic Ammonia Removal (VPCAR)	model for space station application [NASA-CR-181221] p 45 N87-27702
June 23-25, 1986 p 111 A87-35282	[SAE PAPER 860985] p 50 A87-38764 ANALOG SIMULATION	APPROPRIATIONS
AIRCRAFT CONTROL	The effect of nonlinearities on flexible structures	National Aeronautics and Space Administration
Control operations in advanced aerospace systems p 54 A87-32117	[AD-A181735] p 38 N87-27259	Authorization Act [S-REPT-100-87] p 171 N87-24240
AIAA Guidance, Navigation and Control Conference,	ANGULAR ACCELERATION  Tracking and pointing maneuvers with slew-excited	National Aeronautics and Space Administration
Monterey, CA, Aug. 17-19, 1987, Technical Papers.	deformation shaping	Authorization Act, fiscal year 1988
Volumes 1 & 2 p 60 A87-50401 Singular perturbation analysis of AOTV related trajectory	[AIAA PAPER 87-2599] p 62 A87-50561 ANGULAR MOMENTUM	[H-REPT-100-204] p 171 N87-25024
optimization problems	Choice of the optimal angular position of a spacecraft	NASA authorization: Authorization of appropriations for the National Aeronautics and Space Administration for
[NASA-CR-180301] p 137 N87-26927	in the constant-solar-orientation flight segment	fiscal year 1988
AIRCRAFT GUIDANCE AIAA Guidance, Navigation and Control Conference,	p 148 A87-34207 Dynamics of gyroelastic spacecraft p 59 A87-47811	[GPO-73-245] p 172 N87-30221 APSIDES
Monterey, CA, Aug. 17-19, 1987, Technical Papers.	Proposed CMG momentum management scheme for	Orbital modifications using forced tether-length
Volumes 1 & 2 p 60 A87-50401  AIRCRAFT NOISE	space station	variations p 124 A87-40858
Documentation of the space station/aircraft acoustic	[AIAA PAPER 87-2528] p 62 A87-50531 Adaptive momentum management for the dual keel	ARCHITECTURE Space station group activities habitability module study
apparatus	Space Station	[NASA-CR-4010] p 165 N87-21585
[NASA-TM-89111] p 140 N87-20795 AIRCRAFT STRUCTURES	[AIAA PAPER 87-2596] p 62 A87-50558	ARCHITECTURE (COMPUTERS)
Structures, Structural Dynamics and Materials	Space station momentum management p 64 N87-20668	System architecture for the telerobotic work system [AAS PAPER 86-044] p.99 A87-32746
Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA	ANGULAR VELOCITY	The hardware/software architecture of the Columbus
Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Parts 2A & 2B	Space Station/Shuttle Orbiter dynamics during	pressurized module element
p 15 A87-33654	docking p 65 N87-22708  ANIMALS	[AIAA PAPER 87-2211] p 154 A87-48596 Space operations: NASA's use of information
ALGAE The growth and harvesting of algae in a micro-gravity	Plant and animal accommodation for Space Station	technology. Report to the Chairman, Committee on
environment p 165 N87-20325	Laboratory	Science, Space and Technology
ALGORITHMS	[SAE PAPER 860975] p 124 A87-38757 ANISOTROPIC MEDIA	[GAO/IMTEC-87-20] p 137 N87-22551 Attitude and Orientation System (AOCS) tasks on
Practical implementation of an accurate method for multilevel design sensitivity analysis	Localization in disordered periodic structures	Rendezvous and Docking (RVD) (docking-undocking
[AIAA PAPER 87-0718] p 6 A87-33560	[AIAA PAPER 87-0819] p 19 A87-33757	phases). Architecture of the whole simulator, volume 2 [LP-RP-Al-204-VOL-2] p 68 N87-24490
Proposed CMG momentum management scheme for space station	ANTENNA ARRAYS  The evolution of the geostationary platform concept	Mass storage systems for data transport in the early
[AIAA PAPER 87-2528] p 62 A87-50531	p 125 A87-43154	space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443
The multi-disciplinary design study. A life cycle cost algorithm	ANTENNA COMPONENTS	Automated Subsystem Control for Life Support System
[NASA-CR-178192] p 9 N87-21995	Design considerations for a one-kilometer antenna stick	(ASCLSS)
Large space structures ground experiment checkout	[AIAA PAPER 87-0871] p 15 A87-33635	[NASA-CR-172003] p 53 N87-29117 Proceedings: Computer Science and Data Systems
p 30 N87-22704 Identification of large space structures: A	Composite space antenna structures - Properties and environmental effects p 20 A87-38610	Technical Symposium, volume 1
state-of-practice report p 31 N87-22705	environmental effects p 20 A87-38610 ANTENNA DESIGN	[NASA-TM-89285] p 116 N87-29124 Proceedings: Computer Science and Data Systems
Flexible spacecraft simulator p 31 N87-22718  Moving-bank multiple model adaptive estimation applied	Design considerations for a one-kilometer antenna	Technical Symposium, volume 2
to flexible spacestructure control	stick [AIAA PAPER 87-0871] p 15 A87-33635	[NASA-TM-89286] p 116 N87-29144
[AD-A178870] p 68 N87-22761	Box truss antenna technology status	MAX: A space station computer option p 116 N87-29146
An integrated, optimization-based approach to the design and control of large space structures	p 87 N87-24503	Fiber optic data systems p 117 N87-29152
[AD-A179459] p 34 N87-23683	ANTENNA RADIATION PATTERNS	User data management p 4 N87-29163 ARIANE LAUNCH VEHICLE
Large spacecraft pointing and shape control	Shape control of the directional pattern in a microwave-beam power transmission channel	The European space programme p 150 A87-37962
p 69 N87-24498 Distributed control using linear momentum exchange	p 148 A87-34345	Ariane transfer vehicle (ATV) to supply Space Station
devices	Effects of space plasma discharge on the performance	[AIAA PAPER 87-1862] p 152 A87-45257 ARM (ANATOMY)
[NASA-TM-100308] p 70 N87-24521 A comparison between IMSC, PI and MIMSC methods	of large antenna structures in low Earth orbit [NASA-TM-89118] p 86 N87-20339	A comparison between space suited and unsuited reach
in controlling the vibration of flexible systems	Hoop/column and tetrahedral truss electromagnetic	envelopes p 47 A87-33013
[NASA-CR-181156] p 36 N87-25605	tests p 87 N87-24504	Desirability of arms-in capability in space suits [SAE PAPER 860951] p 49 A87-38738
Projection filters for modal parameter estimate for flexible structures	ANTENNAS  Measurement apparatus and procedure for the	ARMED FORCES (UNITED STATES)
[NASA-CR-180303] p 38 N87-26583	determination of surface emissivities	Military man in space: A history of Air Force efforts to find a manned space mission
Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and	[NASA-CASE-LAR-13455-1] p 29 N87-21206	[AD-A179873] p 171 N87-25815
large flexible structures	Technology for Large Space Systems. A bibliography with indexes (supplement 17)	ARRAYS
[AD-A183302] p 11 N87-29893	[NASA-SP-7046(17)] p 39 N87-29576	Maximum likelihood identification using an array processor p 5 A87-32121
		,

	ASTRONOMICAL PHOTOGRAPHY	One Controller at a Time (1-CAT): A mimo design
Performance characteristics of a combination solar	Qualification of the faint object camera	methodology p 65 N87-22715
photovoltaic heat engine energy converter [NASA-TM-89908] p 78 N87-23028	p 127 N87-20359	Workshop on Structural Dynamics and Control
[NASA-TM-89908] p 78 N87-23028 ARTIFICIAL GRAVITY	ASTRONOMY	Interaction of Flexible Structures p 32 N87-22728
A question of gravity p 1 A87-32116	Prospects for space science	Dual keel space station control/structures interaction study p 67 N87-22737
ARTIFICIAL INTELLIGENCE	[AAS PAPER 86-106] p 170 A87-53085	study p 67 N87-22737 Space station structural dynamics/reaction control
An Al-based model-adaptive approach to flexible	ASTROPHYSICS	system interaction study p 67 N87-22753
structure control	Astronomic Telescope Facility: Preliminary systems	Automatic docking maneuver and attitude control s
[AIAA PAPER 87-2457] p 61 A87-50503	definition study report. Volume 2: Technical description	vstem p 71 N87-25395
Space Station autonomy - What are the challenges?	[NASA-TM-89429-VOL-2] p 129 N87-22570	Study on investigation of the attitude control of large
How can they be met? p 101 A87-53059	Astrometric Telescope Facility preliminary systems definition study. Volume 1: Executive summary	flexible spacecraft. Phase 1, volume 1: Technical report
Study of expert system applications to space projects [NF-51-867] p 115 N87-26057	[NASA-TM-89429-VOL-1] p 129 N87-22571	[ESA-CR(P)-2361-VOL-1] p 73 N87-27706
	USSR Report: Space	Study on investigation of the attitude control of large
ARTIFICIAL SATELLITES Satellite servicing mission preliminary cost estimation	[JPRS-USP-86-004] p 158 N87-27687	flexible spacecraft. Phase 2, volume 1: Executive summary
model	ATMOSPHERIC DENSITY	laboratory test model FESA-CR(P)-2361-VOL-11 p 73 N87-27707
[NASA-CR-171978] p 136 N87-20335	Upper and Middle Atmospheric Density Modeling	[ESA-CR(P)-2361-VOL-1] p 73 N87-27707 Study on the investigation of the attitude control of large
Low frequency vibration testing on satellites	Requirements for Spacecraft Design and Operations	flexible spacecraft. Phase 2, volume 2: Technical report
p 27 N87-20364	[NASA-CP-2460] p 64 N87-20665	laboratory test model
ASSAYING	Density uncertainty effect on cost of space station repost p 170 N87-20667	[ESA-CR(P)-2361-VOL-2] p 73 N87-27708
Preliminary study of a Biological and Biochemical		Study on investigation of the attitude control of large
Analysis Facility (BBAF) for Columbus: Executive	Space station momentum management p 64 N87-20668	flexible spacecraft, phase 3
summary (FSA_CR(P)-2338) p 158 N87-27698	Aero-Assisted Orbital Transfer Vehicle (AOTV)	[ESA-CR(P)-2361-VOL-4] p 73 N87-27709
[ESA-CR(P)-2338] p 158 N87-27698 ASTRODYNAMICS	p 3 N87-20682	ATTITUDE STABILITY
The Mast Flight System dynamic characteristics and	ATMOSPHERIC EFFECTS	Dynamic and thermal effects in very large space structures p 25 N87-20347
actuator/sensor selection and location	Effects of atmosphere on slewing control of a flexible	
[AAS PAPER 86-003] p 13 A87-32729	structure p 22 A87-47809	An analysis of space station motion subject to the
Proceedings of the Second International Symposium on	ATMOSPHERIC MODELS	parametric excitation of periodic elevator motion [AD-A179235] p 68 N87-23681
Spacecraft Flight Dynamics	Upper and Middle Atmospheric Density Modeling	(,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
(ESA-SP-255) p 171 N87-25354	Requirements for Spacecraft Design and Operations [NASA-CP-2460] p 64 N87-20665	AURORAL IRRADIATION  Spacecraft charging in the auroral plasma: Progress
Dynamics during thrust maneuvers of flexible spinning		toward understanding the physical effects involved
satellites with axial and radial booms p 71 N87-25355	ATMOSPHERIC SOUNDING Report of the atmosphere panel p 161 N87-20633	p 142 N87-26949
ASTROMETRY Astrometric telescope of ten microarcsecond accuracy	ATOMIC BEAMS	AURORAL ZONES
on the Space Station p 122 A87-35222	The Vanderbilt University neutral O-beam facility	Spacecraft charging in the auroral plasma: Progress
An astrometric facility for planetary detection on the	p 105 A87-32059	toward understanding the physical effects involved
Space Station p 127 A87-50750	High intensity 5 eV CW laser sustained 0-atom exposure	p 142 N87-26949
An astrometric facility for planetary detection on the	facility for material degradation studies	AUTOCODERS
space station	p 105 A87-32060	Automated software production
INASA-TM-R94361 D 128 N87-20841	Martin Marietta atomic oxygen beam facility p 139 A87-38622	[AIAA PAPER 87-2219] p 2 A87-48601
Astronomic Telescope Facility: Preliminary systems	A high flux pulsed source of energetic atomic oxygen	AUTOMATIC CONTROL
definition study report. Volume 2: Technical description [NASA-TM-89429-VOL-2] p 129 N87-22570	for spacecraft materials ground testing	Control operations in advanced aerospace systems p 54 A87-32117
[NASA-TM-89429-VOL-2] p 129 N87-22570 Astrometric Telescope Facility preliminary systems	p 139 A87-38623	
definition study. Volume 1: Executive summary	Production of a beam of ground state oxygen atoms	Variable structure controller design for spacecraft
[NASA-TM-89429-VOL-1] p 129 N87-22571	of selectable energy p 139 A87-38624	nutation damping p 58 A87-39958 Control of an autonomous spacecraft rendezvous and
ASTRONAUT PERFORMANCE	Production of pulsed atomic oxygen beams via laser	docking maneuver by means of image processing
Desirability of arms-in capability in space suits	vaporization methods p 106 A87-38625	[DGLR PAPER 86-122] p 101 A87-48156
[SAF PAPER 860951] p 49 A87-38738	Variable energy, high flux, ground-state atomic oxygen	SAGA: A project to automate the management of
The development of an EVA Universal Work Station	source [NASA-CASE-NPO-16640-1-CU] p 8 N87-21661	software production systems
[SAE PAPER 860952] p 164 A87-38739	Proceedings of the NASA Workshop on Atomic Oxygen	[NASA-CR-180276] p 10 N87-27412
Physiological aspects of EVA  [SAF PAPER 860991] p 164 A87-38768	Effects low earth orbital environment	Automated Subsystem Control for Life Support System
[SAE PAPER 860991] p 164 A87-38768 Advanced orbital servicing capabilities development	[NASA-CR-181163] p 141 N87-26173	(ASCLSS)
[SAE PAPER 860992] p 134 A87-38769	High intensity 5 eV atomic oxygen source and Low Earth	[NASA-CR-172003] p 53 N87-29117
The next step for the MMU - Capabilities and	Orbit (LEO) simulation facility p 141 N87-26186	The preloadable vector sensitive latch for orbital
enhancements	Neutral atomic oxygen beam produced by ion charge	docking/berthing p 162 N87-29876
[SAE PAPER 861013] p 160 A87-38783	exchange for Low Earth Orbital (LEO) simulation	AUTOMATIC PILOTS
ASTRONAUTICS	p 131 N87-26188	Mass property estimation for control of asymmetrical
International Symposium on Space Technology and	Pulsed source of energetic atomic oxygen p 108 N87-26189	satellites p 63 A87-52968
Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings, Volumes 1 & 2 p 166 A87-32276	Production of pulsed atomic oxygen beams via laser	AUTOMATION
Proceedings. Volumes 1 & 2 p 166 A87-32276 EASCON '86; Proceedings of the Nineteenth Annual	vaporization methods p 109 N87-26190	Overview of the NASA automation and robotics research program p 100 A87-33867
Electronics and Aerospace Systems Conference,	The production of low-energy neutral oxygen beams by	Manned spacecraft automation and robotics
Washington, DC, Sept. 8-10, 1986 p. 2 A87-40351	grazing-incidence neutralization p 131 N87-26191	p 100 A87-37300
Space: New opportunities for all people; Selected	Groundbased studies of spacecraft glow and erosion	Life Sciences Research Facility automation
Proceedings of the Thirty-seventh International	caused by impact of oxygen and nitrogen beams	requirements and concepts for the Space Station
Astronautical Congress, Innsbruck, Austria, Oct. 4-11,	p 109 N87-26200	[SAE PAPER 860970] p 50 A87-38752
1986 p 168 A87-41568	Martin Marietta atomic oxygen Low Earth Orbit (LEO) simulation p 142 N87-26204	Planning for space robotics developments and
The Gagarin scientific lectures in astronautics and aviation 1985 Russian book p 152 A87-42923	simulation p 142 N87-20204  ATS 6	applications p 135 A87-40377
aviation. 1985 Russian book p 152 A87-42923 The Gagarin Scientific Lectures on Astronautics and	Automatic charge control system for geosynchronous	Space: New opportunities for all people; Selected
Aviation, 1986 Book p 169 A87-51869	satellites p 87 N87-26960	Proceedings of the Thirty-seventh International
ASTRONAUTS	ATTENUATORS	Astronautical Congress, Innsbruck, Austria, Oct. 4-11,
Living in space: A handbook for space travellers	An electromechanical attenuator/actuator for Space	1986 p 168 A87-41568
p 162 A87-33475	Station docking p 138 N87-29878	Analysis and implementation of automation aspects in
The station is raising lots of questions about space	ATTITUDE (INCLINATION)	the Columbus and Hermes end to end systems
law p 167 A87-34597	Choice of the optimal angular position of a spacecraft	[AIAA PAPER 87-2210] p 154 A87-48595
An evaluation of options to satisfy Space Station EVA	in the constant-solar-orientation flight segment p 148 A87-34207	AUTONOMY
requirements (SAF PAPER 861008) p 134 A87-38780	ATTITUDE CONTROL	Autonomous decentralized system concept for Space Station p 146 A87-32541
[SAE PAPER 861008] p 134 A87-38780  Dynamic behavior of astronauts and satellites outside	Dynamic and attitude control characteristics of an	A comparison of scheduling algorithms for autonomous
an orbiting space station under the influence of thrust	International Space Station	management of the Space Station electric energy
p 52 A87-41666	[AIAA PAPER 87-0931] p 57 A87-33731	system
The astronaut and the robot - Short- and long-term	A study on singularity of single gimbal CMG systems	[AIAA PAPER 87-2467] p 77 A87-50511
scenarios for space technology p 101 A87-53991	p 149 A87-35077	Space Station autonomy - What are the challenges?
Developing a voice-controlled, computer-generated	An approach to structure/control simultaneous	How can they be met? p 101 A87-53059
display to assist space station astronauts during	optimization for large flexible spacecraft p 22 A87-46793	Self-calibration strategies for robot manipulators
maintenance activity	Robust nonlinear attitude control of flexible spacecraft	p 102 N87-26355
[AD-A178997] p 120 N87-22762	p 60 A87-48273	AUXILIARY PROPULSION
Bi-stem gripping apparatus [NASA-CASE-MFS-28185-1] p 107 N87-25586	On-line identification and attitude control for SCOLE	Preliminary performance characterizations of an
ASTRONOMICAL OBSERVATORIES	[AIAA PAPER 87-2459] p 61 A87-50505	engineering model multipropellant resistojet for space
'HEXE' - X-ray observatory in space	Propellant tank resupply system	station application [AIAA PAPER 87-2120] p 93 A87-50197
p 155 A87-53558	[AD-D012559] p 93 N87-20375	[AIAA PAPER 87-2120] p 93 A87-50197

coupled bending-torsion unstalled supersonic flutter [ASME PAPER 86-GT-100] p 166 A87-2

Control of a flexible space manipulator

A new approach for vibration control in large space

BENDING MOMENTS

BENDING VIBRATION

structures

p 166 A87-25396

p 33 N87-22743

p 99 A87-32449

A quasi-analytical method for non-iterative computation

Preliminary performance characterizations of an Dynamic characteristics of a vibrating beam with periodic engineering model multipropellant resistojet for space station application variation in bending stiffness p 32 N87-22726 **BIBLIOGRAPHIES** [NASA-TM-100113] p 96 N87-23821 Space station systems: A bibliography with indexes AVIONICS supplement 4) Space Station integration and verification concepts [NASA-SP-7056(04)] p 4 N87-26073 p 84 A87-31461 Technology for Large Space Systems. A bibliography ith indexes (supplement 17) System level verification applying the Space Shuttle [NASA-SP-7046(17)] experience to the Space Station p 39 N87-29576 BINDERS (MATERIALS) **IAAS PAPER 86-0011** p 55 A87-32727 Space Station lubrication considerations **AXES (REFERENCE LINES)** p 104 N87-29879 Multi-axis vibration tests on spacecraft using hydraulic **BIOASSAY** p8 N87-20373 Expansion of space station diagnostic capability to AXIAL COMPRESSION LOADS include serological identification of viral and bacterial Effect of transverse shearing forces on buckling and p 53 N87-26703 postbuckling of delaminated composites infections under Preliminary study of a Biological and Biochemical compressive loads Analysis Facility (BBAF) for Columbus: Executive [AIAA PAPER 87-0877] p 105 A87-33639 AXIAL STRESS summary [ESA-CR(P)-2338] p 158 N87-27698 Analytical solutions for static elastic deformations of wire BIOASTRONAUTICS Space Station - Opportunities for the life sciences [AIAA PAPER 87-0720] p 6 A87-33561 p 122 A87-34871 Plant and animal accommodation for Space Station Laboratory [SAE PAPER 860975] p 124 A87-38757 Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967 **BACTERIAL DISEASES** Expansion of space station diagnostic capability to include serological identification of viral and bacterial The human quest in space; Proceedings of the Twenty-fourth Goddard Memorial Symposium, Greenbelt, p 53 N87-26703 infections BALL BEARINGS Development of harmonic drive actuator for space MD, Mar. 20, 21, 1986 p 2 A87-53082 p 149 A87-35076 manipulator **BIOCHEMISTRY BALLISTIC VEHICLES** Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive The single-stage reusable ballistic launcher concept for summary [ESA-CR(P)-2338] economic cargo transportation p 135 A87-41573 BAYES THEOREM p 158 N87-27698 A computer program for model verification of dynamic BIODYNAMICS svstems A comparison between space suited and unsuited reach p 31 N87-22710 BAYS (STRUCTURAL UNITS) envelopes nvelopes p 47 A87-33013 U.S. National Congress of Applied Mechanics, 10th, Shuttle middeck fluid transfer experiment: Lessons learned p 95 N87-21158 University of Texas, Austin, June 16-20, 1986, Deployable geodesic truss structure [NASA-CASE-LAR-13113-1] **Proceedings** p 36 N87-25492 n 1 A87-40051 BEAM CURRENTS Effect of crew motions on the spatial position of a BIOLOGICAL MODELS (MATHEMATICS)

ISOKIN - A quantification Electron beam experiments at high altitudes p 142 N87-26946 BEAMS (SUPPORTS) ISOKIN - A quantitative model of the kinesthetic aspects Structure and function of Deployable Truss Beam of spatial habitability p 162 A87-33002
BLACK BRANT SOUNDING ROCKETS p 12 A87-32548 Identification of the zero-g shape of a space beam Preliminary results of CHARGE-2 tethered payload [AIAA PAPER 87-0872] p 15 A87-33636 experiment p 121 A87-32521 Effect of transverse shearing forces on buckling and **BODY KINEMATICS** postbuckling of delaminated compressive loads Evaluation of constraint stabilization procedures for composites multibody dynamical systems [AIAA PAPER 87-0927] [AIAA PAPER 87-0877] p 105 A87-33639 p 7 A87-33728 Accuracy of derivatives of control performance using a BODY MEASUREMENT (BIOLOGY) reduced structural model Space suit reach considerations strength envelope [AIAA PAPER 87-0905] p 57 A87-33714 Control of flexible structures by applied thermal [SAE PAPER 860950] p 49 A87-38737 gradients p 21 A87-39543 BOILING Modeling, stabilization and control of serially connected Determination of the cross-sectional temperature beams p 21 A87-41052 distribution and boiling limitation of a heat pipe Active vibration control of a simply supported beam using p 40 A87-32175 a spatially distributed actuator Verification of large beam-type space structures Effect of bonding on the performance of a piezoactuator-based active control system p 31 N87-22712 Dynamics of trusses having nonlinear joints [NASA-CR-181414] p 74 N87-29713 **BOOMS (EQUIPMENT)** p 32 N87-22724 Design, development and fabrication of a Dynamics during thrust maneuvers of flexible spinning deployable/retractable truss beam model for large space satellites with axial and radial booms p 71 N87-25355 structures application Dynamic analysis of the flexible boom in the N-ROSS [NASA-CR-178287] p 35 N87-25349 Bi-stem gripping apparatus [NASA-CASE-MFS-28185-1] [AD-A1814881 p 72 N87-26966 p 107 N87-25586 Computer simulation of a rotational single-element Effect of bonding on the performance of a flexible spacecraft boom piezoactuator-based active control system [AD-A181798] p 103 N87-26968 [NASA-CR-181414] p 74 N87-29713 Folding, articulated, square truss p 40 N87-29859 The design and development of a two-dimensional adaptive truss structure p 40 N87-29860
Optimum shape control of flexible beams by **BOTANY** Life Support Subsystem concepts for botanical experiments of long duration piezo-electric actuators [SAE PAPER 860967] [NASA-CR-181413] p 49 A87-38749 p 40 N87-29898 Life support subsystem concepts for botanical BEARINGS A hybrid nonlinear programming method for design experiments of long duration [MBB-UR-E-907-86-PUB] optimization p 7 A87-35718 p 154 A87-49967 Botanical payloads for platforms and space stations The effect of circumferential aerodynamic detuning on [MBB-UR-E-921/86] p 158 N87-25340

**BOUNDARY VALUE PROBLEMS** 

[AIAA PAPER 87-0746]

[AIAA PAPER 87-0941]

truss structures

System identification of a truss type space structure

Effects of local vibrations on the dynamics of space

p 16 A87-33670

p 17 A87-33739

using the multiple boundary condition test (MBCT)

of nonlinear controls p 66 N87-22731 A new approach for vibration control in large space p 33 N87-22743 structures The dynamics and control of large flexible space tructures X, part 1 [NASA-CR-181287] p 73 N87-27712 BRAKING Common drive unit p 104 N87-29869 **BRAYTON CYCLE** Optimization of heat rejection subsystem for solar dynamic Brayton cycle power system [SAE PAPER 860999] p 43 A87-38776 Speculations on future opportunities to evolve Brayton powerplants aboard the space station [NASA-TM-89863] p 121 N87-23674 BREMSSTRAHLUNG High energy gamma ray astronomy p 129 N87-24258 BUBBLES Liquid propellant tank ullage bubble deformation and breakup in low gravity reorientation [AIAA PAPER 87-2021] p 92 A87-45360 BUCKLING Effect of transverse shearing forces on buckling and postbuckling of delaminated composites under compressive loads [AIAA PAPER 87-0877] p 105 A87-33639 C **CABIN ATMOSPHERES** Concept study of regenerable carbon dioxide removal and oxygen recovery system for the Space Station p 46 A87-32544 CABLES (ROPES) Analytical solutions for static elastic deformations of wire ropes [AIAA PAPER 87-0720] p.6 A87-33561 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 CALIBRATING Panel report on new approaches to calibration and validation --- Columbus polar platforms p 157 N87-20638 Mass spectrometers and atomic oxygen p 141 N87-26176 Self-calibration strategies for robot manipulators p 102 N87-26355 Absolute indoor calibration of large area solar cells p 159 N87-29015 **CANADIAN SPACE PROGRAM** The Canadian space program p 143 A87-32281 The Canadian Robotic System for the Space Station IAA PAPER 87-1677] p 100 A87-41153 [AIAA PAPER 87-1677] The Space Station overview p 168 A87-41571 CANTILEVER BEAMS Space structure vibration modes - How many exist? Which ones are important? p 11 A87-32120 Positive position feedback control for large space structures AIAA PAPER 87-0902] p 17 A87-33711 CARBON Laboratory studies of atomic oxygen reactions with p 4 N87-26185 CARBON DIOXIDE CONCENTRATION EDC development and testing for the Space Station rogram Electrochemical Carbon Dioxide Concentration [SAE PAPER 860918] p 118 A87-38710 CARBON DIOXIDE REMOVAL Development of carbon dioxide removal system -Experimental study of solid amines p 145 A87-32456 Concept study of regenerable carbon dioxide removal and oxygen recovery system for the Space Station p 46 A87-32544 An advanced carbon reactor subsystem for carbon dioxide reduction [SAE PAPER 860995] p 51 A87-38772 Complex system monitoring and fault diagnosis using communicating expert systems p 11
CARBON FIBER REINFORCED PLASTICS p 119 A87-40363 Carbon fibre slotted waveguide arrays p 85 A87-41302 PEEK (Polyether ether ketone) with 30 percent of carbon fibres for injection molding p 22 A87-44588 Development of full scale deployable CFRP truss for space structure p 25 A87-51793 **CARBON FIBERS** Effects on advanced materials: Results of the STS-8 EOIM (Effects of Oxygen Interaction with Materials) experiment [AD-A182931] p 110 N87-29709

p 41 A87-32668

p 65 N87-22060

p 172 N87-29155

p 149 A87-35877

p 160 A87-32549

p 167 A87-38576

p 20 A87-38609

p 72 N87-26966

p 110 N87-29709

p 105 A87-33639

p 20 A87-38601

p 20 A87-38612

p 160 A87-45441

p 22 A87-47327

p 30 N87-22269

p 11 N87-29893

p 40 N87-29899

p 108 N87-26182

p 109 N87-26201

### CARBON-CARBON COMPOSITES

ADDOM COMPOSITES	
ARBON-CARBON COMPOSITES	CLOUDS Station
Evaluation of carbon-carbon for space engine nozzle	External contamination environment of Space Station
p 98 N87-26116	Customer Servicing Facility [AIAA PAPER 87-1623] p 52 A87-43122
ARGO SPACECRAFT Mir in action p 150 A87-37971	COATINGS
ASSEGRAIN ANTENNAS	Effects on advanced materials: Results of the STS-8
On-board K- and S-band multi-beam antennas	EOIM (Effects of Oxygen Interaction with Materials)
p 86 A87-46281	experiment [AD-A182931] p 110 N87-29709
ATHODE RAY TUBES	[76-71102001]
Head-ported display analysis for Space Station applications p 111 A87-31463	COAXIAL CABLES  Coaxial tube array space transmission line
ENTER OF GRAVITY	characterization
Instability of an elastic filament in orbit around a	[NASA-TM-89864] p 96 N87-22003
gravitating center p 148 A87-32815	CODING
Space station control moment gyro control p 64 N87-20669	Coded mask telescopes for X-ray astronomy p 123 A87-37785
CENTER OF MASS	•
Mass property estimation for control of asymmetrical	COLD SURFACES  Design of an advanced two-phase capillary cold plate
satellites p 63 A87-52968	[SAE PAPER 861829] p 41 A87-32663
ENTER OF PRESSURE	COLLIMATION
Space station control moment gyro control p 64 N87-20669	Carbon fibre slotted waveguide arrays
CENTRAL PROCESSING UNITS	p 85 A87-41302
A VHSIC general purpose processor	COLUMBUS SPACE STATION  Ariane transfer vehicle (ATV) to supply Space Station
p 116 N87-29145	[AIAA PAPER 87-1862] p 152 A87-45257
CENTRIFUGES	Columbus pressurized modules p 153 A87-46945
Special considerations in outfitting a space station module for scientific use	Analysis and implementation of automation aspects in
[SAE PAPER 860956] p 164 A87-38741	the Columbus and Hermes end to end systems
CHALLENGER (ORBITER)	[AIAA PAPER 87-2210] p 154 A87-48595
Space Shuttle flight rates and utilization	The hardware/software architecture of the Columbus
p 1 A87-37963	pressurized module element [AIAA PAPER 87-2211] p 154 A87-48596
CHANNELS (DATA TRANSMISSION) Star topology spacecraft data bus	Evolution of data management systems from Spacelab
p 112 A87-37431	to Columbus
SS focused technology: Gateways and NOS's	[AIAA PAPER 87-2227] p 154 A87-48605
p 117 N87-29165	The Columbus system baseline and interfaces p 156 A87-53923
Network operating system p 117 N87-29166	The Columbus program p 157 N87-25031
CHARGE EXCHANGE  Neutral atomic oxygen beam produced by ion charge	Botanical payloads for platforms and space stations
exchange for Low Earth Orbital (LEO) simulation	[MBB-UR-E-921/86] p 158 N87-25340
p 131 N87-26188	Possibilities of the further development of Columbus to
CHARGE TRANSFER	an autonomous European space station [MBB-UR-E-922/86] p 158 N87-25418
Investigation of plasma contactors for use with orbiting	COMBUSTION PRODUCTS
wires [NASA-CR-180922] p 129 N87-22509	Hydrogen-oxygen thruster with no products of
CHARGED PARTICLES	combustion in exhaust plume
Documentation for the SHADO particle wake routine	[AIAA PAPER 87-1775] p 91 A87-45196
[AD-A181531] p 131 N87-26967	COMMAND AND CONTROL System architecture for the telerobotic work system
CHEMICAL EFFECTS Oxygen interaction with space-power materials	[AAS PAPER 86-044] p 99 A87-32746
[NASA-CR-181396] p 132 N87-29633	User interface and payload command and control
CHEMICAL REACTIONS	p 73 N87-29162
Kinetics and mechanisms of some atomic oxygen	COMMERCE
reactions p 141 N87-26179	Remote sensing applications: Commercial issues and opportunities for space station SPOT
CHEMICAL REACTORS  An advanced carbon reactor subsystem for carbon	p 156 N87-20626
dioxide reduction	COMMERCIAL SPACECRAFT
[SAE PAPER 860995] p 51 A87-38772	Commercialization of space - The insurance
CIRCUIT PROTECTION	implications p 166 A87-32460
CIRCUIT PROTECTION  Electrostatic immunity of geostationary satellites	implications p 166 A87-32460 The Industrial Space Facility p 167 A87-38579
CIRCUIT PROTECTION  Electrostatic immunity of geostationary satellites p 143 N87-26957	implications p 166 A87-32460 The Industrial Space Facility p 167 A87-38579 COMMUNICATION NETWORKS
CIRCUIT PROTECTION  Electrostatic immunity of geostationary satellites p 143 N87-26957  CIRCULAR PLATES Vibrations and structureborne noise in space station	implications p 166 A87-32460 The Industrial Space Facility p 167 A87-38579 COMMUNICATION NETWORKS The effect of multipath on digital communications systems: With application to space station
CIRCUIT PROTECTION  Electrostatic immunity of geostationary satellites p 143 N87-26957	implications p 166 A87-32460 The Industrial Space Facility p 167 A87-38579 COMMUNICATION NETWORKS The effect of multipath on digital communications systems: With application to space station [AD-A178578] p 86 N87-22876
CIRCUIT PROTECTION  Electrostatic immunity of geostationary satellites p 143 N87-26957  CIRCULAR PLATES Vibrations and structureborne noise in space station [NASA-CR-181381] p 39 N87-29590  CIRCULATION	implications p 166 A87-32460 The Industrial Space Facility p 167 A87-38579 COMMUNICATION NETWORKS The effect of multipath on digital communications systems: With application to space station [AD-A178578] Integration of communications and tracking data
CIRCUIT PROTECTION  Electrostatic immunity of geostationary satellites p 143 N87-26957  CIRCULAR PLATES Vibrations and structureborne noise in space station [NASA-CR-181381] p 39 N87-29590  CIRCULATION Perturbation analysis of internal balancing for lightly	implications p 166 A87-32460 The Industrial Space Facility p 167 A87-38579  COMMUNICATION NETWORKS The effect of multipath on digital communications systems: With application to space station [AD-A178578] p 86 N87-22876 Integration of communications and tracking data processing simulation for space station
CIRCUIT PROTECTION  Electrostatic immunity of geostationary satellites p 143 N87-26957  CIRCULAR PLATES Vibrations and structureborne noise in space station [NASA-CR-181381] p 39 N87-29590  CIRCULATION Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and	implications p 166 A87-32460 The Industrial Space Facility p 167 A87-38579 COMMUNICATION NETWORKS The effect of multipath on digital communications systems: With application to space station [AD-A178578] Integration of communications and tracking data
CIRCULT PROTECTION  Electrostatic immunity of geostationary satellites p 143 N87-26957  CIRCULAR PLATES Vibrations and structureborne noise in space station [NASA-CR-181381] p 39 N87-29590  CIRCULATION  Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 22 A87-47812  CIVIL AVIATION	implications p 166 A87-32460 The Industrial Space Facility p 167 A87-38579  COMMUNICATION NETWORKS The effect of multipath on digital communications systems: With application to space station [AD-A178578] p 86 N87-22876 Integration of communications and tracking data processing simulation for space station  Network reliability p 115 N87-25890 Pommunication SATELLITES
CIRCUIT PROTECTION  Electrostatic immunity of geostationary satellites p 143 N87-26957  CIRCULAR PLATES Vibrations and structureborne noise in space station [NASA-CR-181381] p 39 N87-29590  CIRCULATION Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 22 A87-47812  CIVIL AVIATION Toward the year 2000: The near future of the American	implications p 166 A87-32460 The Industrial Space Facility p 167 A87-38579 COMMUNICATION NETWORKS The effect of multipath on digital communications systems: With application to space station p 86 N87-22876 Integration of communications and tracking data processing simulation for space station p 115 N87-25890 Network reliability p 117 N87-25890 Precise pointing control of flexible spacecraft
CIRCUIT PROTECTION  Electrostatic immunity of geostationary satellites p 143 N87-26957  CIRCULAR PLATES Vibrations and structureborne noise in space station [NASA-CR-181381] p 39 N87-29590  CIRCULATION Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 22 A87-47812  CIVIL AVIATION Toward the year 2000: The near future of the American civilian and military space programs	implications p 166 A87-32460 The Industrial Space Facility p 167 A87-38579  COMMUNICATION NETWORKS The effect of multipath on digital communications systems: With application to space station  [AD-A178578] p 86 N87-22876  Integration of communications and tracking data processing simulation for space station  Network reliability p 115 N87-25890  Precise pointing control of flexible spacecraft p 55 A87-32446
CIRCULT PROTECTION  Electrostatic immunity of geostationary satellites p 143 N87-26957  CIRCULAR PLATES Vibrations and structureborne noise in space station [NASA-CR-181381]  CIRCULATION  Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 22 A87-47812  CIVIL AVIATION  Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697	implications p 166 A87-32460 The Industrial Space Facility p 167 A87-38579  COMMUNICATION NETWORKS The effect of multipath on digital communications systems: With application to space station [AD-A178578] p 86 N87-22876 Integration of communications and tracking data processing simulation for space station  Network reliability p 115 N87-25890 Network reliability p 117 N87-29157  COMMUNICATION SATELLITES Precise pointing control of flexible spacecraft p 55 A87-32446  Communication missions for geostationary platforms
CIRCULT PROTECTION  Electrostatic immunity of geostationary satellites p 143 N87-26957  CIRCULAR PLATES Vibrations and structureborne noise in space station [NASA-CR-181381] p 39 N87-29590  CIRCULATION Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 22 A87-47812  CIVIL AVIATION Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697	implications p 166 A87-32460 The Industrial Space Facility p 167 A87-38579 COMMUNICATION NETWORKS The effect of multipath on digital communications systems: With application to space station [AD-A178578] p 86 N87-22876 Integration of communications and tracking data processing simulation for space station Network reliability p 117 N87-25890 Network reliability p 117 N87-29157 COMMUNICATION SATELLITES Precise pointing control of flexible spacecraft p 55 A87-32446 Communication missions for geostationary platforms p 84 A87-34797 Modal-survey testing of the Olympus spacecraft
CIRCUIT PROTECTION  Electrostatic immunity of geostationary satellites p 143 N87-26957  CIRCULAR PLATES Vibrations and structureborne noise in space station [NASA-CR-181381] p 39 N87-29590  CIRCULATION Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 22 A87-47812  CIVIL AVIATION Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697  CLOSED CYCLES Air Evaporation closed cycle water recovery technology	implications p 166 A87-32460 The Industrial Space Facility p 167 A87-38579  COMMUNICATION NETWORKS The effect of multipath on digital communications systems: With application to space station [AD-A178578] p 86 N87-22876 Integration of communications and tracking data processing simulation for space station  Network reliability p 115 N87-25890 Network reliability p 117 N87-29157  COMMUNICATION SATELLITES Precise pointing control of flexible spacecraft  Communication missions for geostationary platforms
CIRCULT PROTECTION  Electrostatic immunity of geostationary satellites p 143 N87-26957  CIRCULAR PLATES Vibrations and structureborne noise in space station [NASA-CR-181381] p 39 N87-29590  CIRCULATION Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces CIVIL AVIATION Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697  CLOSED CYCLES Air Evaporation closed cycle water recovery technology - Advanced energy saving designs [SAE PAPER 860987] p 51 A87-38766	implications p 166 A87-32460 The Industrial Space Facility p 167 A87-38579  COMMUNICATION NETWORKS The effect of multipath on digital communications systems: With application to space station [AD-A178578] p 86 N87-22876 Integration of communications and tracking data processing simulation for space station p 115 N87-25890  Network reliability p 117 N87-29157  COMMUNICATION SATELLITES Precise pointing control of flexible spacecraft p 55 A87-32446  Communication missions for geostationary platforms p 84 A87-34797  Modal-survey testing of the Olympus spacecraft p 152 A87-32266  Japan's space development programs for control of programs for communication p 150 A87-42666
CIRCULT PROTECTION  Electrostatic immunity of geostationary satellites p 143 N87-26957  CIRCULAR PLATES Vibrations and structureborne noise in space station [NASA-CR-181381] p 39 N87-29590  CIRCULATION Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 22 A87-47812  CIVIL AVIATION Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697  CLOSED CYCLES Air Evaporation closed cycle water recovery technology - Advanced energy saving designs [SAE PAPER 860987] p 51 A87-38766 Optimization of heat rejection subsystem for solar	implications p 166 A87-32460 The Industrial Space Facility p 167 A87-32450 COMMUNICATION NETWORKS The effect of multipath on digital communications systems: With application to space station [AD-A178578] p 86 N87-22876 Integration of communications and tracking data processing simulation for space station Network reliability p 115 N87-25890 Network reliability p 117 N87-29157 COMMUNICATION SATELLITES Precise pointing control of flexible spacecraft p 55 A87-32446 Communication missions for geostationary platforms p 84 A87-34797 Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Japan's space development programs for communications - An overview p 152 A87-43156
CIRCULT PROTECTION  Electrostatic immunity of geostationary satellites p 143 N87-26957  CIRCULAR PLATES Vibrations and structureborne noise in space station [NASA-CR-181381] p 39 N87-29590  CIRCULATION Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 22 A87-47812  CIVIL AVIATION Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697  CLOSED CYCLES Air Evaporation closed cycle water recovery technology - Advanced energy saving designs [SAE PAPER 860987] p 51 A87-38766 Optimization of heat rejection subsystem for solar dynamic Brayton cycle power system	implications p 166 A87-32460 The Industrial Space Facility p 167 A87-38579  COMMUNICATION NETWORKS The effect of multipath on digital communications systems: With application to space station  [AD-A178578] p 86 N87-22876  Integration of communications and tracking data processing simulation for space station  Network reliability p 117 N87-25890  Network reliability p 117 N87-29157  COMMUNICATION SATELLITES  Precise pointing control of flexible spacecraft p 55 A87-32446  Communication missions for geostationary platforms p 84 A87-34797  Modal-survey testing of the Olympus spacecraft p 152 A87-42266  Japan's space development p 152 A87-42266  Evaluation of the infrared test method for the Olympus
CIRCULAR PLATES Vibrations and structureborne noise in space station [NASA-CR-181381] Parturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces  CIVIL AVIATION Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] P 171 N87-22697 CLOSED CYCLES Air Evaporation closed cycle water recovery technology - Advanced energy saving designs [SAE PAPER 860987] Optimization of heat rejection subsystem for solar dynamic Brayton cycle power system [SAE PAPER 860999]  P 43 A87-38776	implications p 166 A87-32460 The Industrial Space Facility p 167 A87-38579  COMMUNICATION NETWORKS The effect of multipath on digital communications systems: With application to space station [AD-A178578] p 86 N87-22876 Integration of communications and tracking data processing simulation for space station  Network reliability p 115 N87-25890 Network reliability p 117 N87-29157  COMMUNICATION SATELLITES Precise pointing control of flexible spacecraft Communication missions for geostationary platforms
CIRCULAR PLATES Vibrations and structureborne noise in space station [NASA-CR-181381]  CIRCULATION Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces  CIVIL AVIATION Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467]  CLOSED CYCLES Air Evaporation closed cycle water recovery technology - Advanced energy saving designs [SAE PAPER 860987]  Optimization of heat rejection subsystem for solar dynamic Brayton cycle power system [SAE PAPER 860999]  P 43 A87-38776  CLOSED CCOLOGICAL SYSTEMS	implications p 166 A87-32460 The Industrial Space Facility p 167 A87-38579  COMMUNICATION NETWORKS  The effect of multipath on digital communications systems: With application to space station [AD-A178578] p 86 N87-22876 Integration of communications and tracking data processing simulation for space station  Network reliability p 117 N87-25890 Network reliability p 117 N87-29157  COMMUNICATION SATELLITES Precise pointing control of flexible spacecraft p 55 A87-32446 Communication missions for geostationary platforms p 84 A87-34797  Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Japan's space development programs for communications - An overview p 152 A87-42156 Evaluation of the infrared test method for the Olympus thermal balance tests p 44 A87-46682 Comparison of different attitude control schemes for large communications satellites
CIRCULAR PLATES Vibrations and structureborne noise in space station [NASA-CR-181381] p 39 N87-29590  CIRCULATION Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 22 A87-47812  CIVIL AVIATION Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697  CLOSED CYCLES Air Evaporation closed cycle water recovery technology - Advanced energy saving designs [SAE PAPER 860987] p 51 A87-38766 Optimization of heat rejection subsystem for solar dynamic Brayton cycle power system [SAE PAPER 860999] p 43 A87-38776  CLOSED ECOLOGICAL SYSTEMS Water recycling for Space Station p 46 A87-32459	implications p 166 A87-32460  The Industrial Space Facility p 167 A87-38579  COMMUNICATION NETWORKS  The effect of multipath on digital communications systems: With application to space station p 86 N87-22876 Integration of communications and tracking data processing simulation for space station p 115 N87-25890  Network reliability p 117 N87-25890  Network reliability p 117 N87-29157  COMMUNICATION SATELLITES  Precise pointing control of flexible spacecraft p 55 A87-32446  Communication missions for geostationary platforms p 84 A87-34797  Modal-survey testing of the Olympus spacecraft p 152 A87-42266  Japan's space development communications - An overview p 152 A87-43166  Evaluation of the infrared test method for the Olympus thermal balance tests p 44 A87-46682  Comparison of different attitude control schemes for large communications satellites  [AIAA PAPER 87-2391] p 61 A87-50475
CIRCULT PROTECTION  Electrostatic immunity of geostationary satellites p 143 N87-26957  CIRCULAR PLATES Vibrations and structureborne noise in space station [NASA-CR-181381] p 39 N87-29590  CIRCULATION  Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 22 A87-47812  CIVIL AVIATION  Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697  CLOSED CYCLES  Air Evaporation closed cycle water recovery technology - Advanced energy saving designs [SAE PAPER 860987] p 51 A87-38766  Optimization of heat rejection subsystem for solar dynamic Brayton cycle power system [SAE PAPER 860999] p 43 A87-38776  CLOSED ECOLOGICAL SYSTEMS  Water recycling for Space Station p 46 A87-32459 CELSS waste management systems evaluation	implications p 166 A87-32460  The Industrial Space Facility p 167 A87-32460  COMMUNICATION NETWORKS  The effect of multipath on digital communications systems: With application to space station p 86 N87-22876 Integration of communications and tracking data processing simulation for space station p 115 N87-25990  Network reliability p 117 N87-25990  Network reliability p 117 N87-29157  COMMUNICATION SATELLITES  Precise pointing control of flexible spacecraft p 55 A87-32446  Communication missions for geostationary platforms p 84 A87-34797  Modal-survey testing of the Olympus spacecraft p 152 A87-42666  Japan's space development programs for communications - An overview p 152 A87-43156  Evaluation of the infrared test method for the Olympus thermal balance tests p 44 A87-46682  Comparison of different attitude control schemes for large communications satellites  [AIAA PAPER 87-2391] p 61 A87-50475  Dynamic analysis of direct television satellites
CIRCULA PROTECTION  Electrostatic immunity of geostationary satellites	implications p 166 A87-32460 The Industrial Space Facility p 167 A87-38579  COMMUNICATION NETWORKS The effect of multipath on digital communications systems: With application to space station [AD-A178578] p 86 N87-22876 Integration of communications and tracking data processing simulation for space station Network reliability p 117 N87-25890 Network reliability p 117 N87-29157  COMMUNICATION SATELLITES Precise pointing control of flexible spacecraft p 55 A87-32446 Communication missions for geostationary platforms p 84 A87-34797  Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Japan's space development p 152 A87-42566 Evaluation of the infrared test method for the Olympus thermal balance tests p 44 A87-46680 Comparison of different attitude control schemes for large communications satellites [AIAA PAPER 87-2391] p 61 A87-50475 Dynamic analysis of direct television satellites relevision satellites p 86 N87-20360
CIRCULT PROTECTION  Electrostatic immunity of geostationary satellites p 143 N87-26957  CIRCULAR PLATES Vibrations and structureborne noise in space station [NASA-CR-181381] p 39 N87-29590  CIRCULATION  Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 22 A87-47812  CIVIL AVIATION  Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697  CLOSED CYCLES Air Evaporation closed cycle water recovery technology - Advanced energy saving designs [SAE PAPER 860987] p 51 A87-38766  Optimization of heat rejection subsystem for solar dynamic Brayton cycle power system [SAE PAPER 860999] p 43 A87-38776  CLOSED ECOLOGICAL SYSTEMS  Water recycling for Space Station p 46 A87-32459 CELSS waste management systems evaluation [SAE PAPER 860997] p 51 A87-38774 Life support subsystem concepts for botanical experiments of long duration	implications p 166 A87-32460  The Industrial Space Facility p 167 A87-32460  COMMUNICATION NETWORKS  The effect of multipath on digital communications systems: With application to space station p 86 N87-22876 Integration of communications and tracking data processing simulation for space station p 115 N87-25990  Network reliability p 117 N87-25990  Network reliability p 117 N87-29157  COMMUNICATION SATELLITES  Precise pointing control of flexible spacecraft p 55 A87-32446  Communication missions for geostationary platforms p 84 A87-34797  Modal-survey testing of the Olympus spacecraft p 152 A87-42666  Japan's space development programs for communications - An overview p 152 A87-43156  Evaluation of the infrared test method for the Olympus thermal balance tests p 44 A87-46682  Comparison of different attitude control schemes for large communications satellites  [AIAA PAPER 87-2391] p 61 A87-50475  Dynamic analysis of direct television satellites
CIRCULAR PLATES Vibrations and structureborne noise in space station [NASA-CR-181381] p 39 N87-29590  CIRCULATION Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 22 A87-47812  CIVIL AVIATION Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697  CLOSED CYCLES Air Evaporation closed cycle water recovery technology - Advanced energy saving designs [SAE PAPER 860987] p 51 A87-38766 Optimization of heat rejection subsystem for solar dynamic Brayton cycle power system [SAE PAPER 860999] p 43 A87-38776  CLOSED ECOLOGICAL SYSTEMS Water recycling for Space Station p 46 A87-32459 CELSS waste management systems evaluation [SAE PAPER 860997] p 51 A87-38774 Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967	implications p 166 A87-32460 The Industrial Space Facility p 167 A87-32460 The Industrial Space Facility p 167 A87-32450 COMMUNICATION NETWORKS The effect of multipath on digital communications systems: With application to space station [AD-A178578] p 86 N87-22876 Integration of communications and tracking data processing simulation for space station  Network reliability p 115 N87-25890 Network reliability p 117 N87-29157 COMMUNICATION SATELLITES Precise pointing control of flexible spacecraft p 55 A87-32446 Communication missions for geostationary platforms p 84 A87-34797 Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Japan's space development programs for communications - An overview p 152 A87-42156 Evaluation of the infrared test method for the Olympus thermal balance tests p 44 A87-46682 Comparison of different attitude control schemes for large communications satellites [AIAA PAPER 87-2391] p 61 A87-50475 Dynamic analysis of direct TV-SAT/TDF-1 Modal testing of the Olympus development model stowed solar array p 27 N87-20366 Plans for industrialization of space discussed
CIRCULAR PLATES Vibrations and structureborne noise in space station [NASA-CR-181381] P 39 N87-29590  CIRCULARION Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces CIVIL AVIATION Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] P 171 N87-22697  CLOSED CYCLES Air Evaporation closed cycle water recovery technology - Advanced energy saving designs [SAE PAPER 860987] SAE PAPER 860987] SAE PAPER 860999] Vater recycling for Space Station CLOSED ECOLOGICAL SYSTEMS Water recycling for Space Station SAE PAPER 860997] Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] P 154 A87-49967 Electrochemical processing of solid waste	implications p 166 A87-32460  The Industrial Space Facility p 167 A87-38579  COMMUNICATION NETWORKS  The effect of multipath on digital communications systems: With application to space station p 86 N87-22876 Integration of communications and tracking data processing simulation for space station p 115 N87-25890  Network reliability p p 117 N87-259157  COMMUNICATION SATELLITES  Precise pointing control of flexible spacecraft p 55 A87-32446  Communication missions for geostationary platforms p 84 A87-34797  Modal-survey testing of the Olympus spacecraft p 152 A87-42266  Japan's space development communications - An overview p 152 A87-43166  Evaluation of the infrared test method for the Olympus thermal balance tests p 44 A87-46682  Comparison of different attitude control schemes for large communications satellites [AIAA PAPER 87-2391]  Dynamic analysis of direct TV-SAT/TDF-1  Modal testing of the Olympus development model stowed solar array Plans for industrialization of space discussed p 157 N87-21979
CIRCULAR PLATES Vibrations and structureborne noise in space station [NASA-CR-181381] P 39 N87-29590  CIRCULATION Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces CIVIL AVIATION Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] CLOSED CYCLES Air Evaporation closed cycle water recovery technology - Advanced energy saving designs [SAE PAPER 860987] Optimization of heat rejection subsystem for solar dynamic Brayton cycle power system [SAE PAPER 8609987] CLOSED ECOLOGICAL SYSTEMS Water recycling for Space Station VAE PAPER 860997 Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] Electrochemical processing of solid waste [NASA-CR-181128] P 137 N87-25443	implications p 166 A87-32460  COMMUNICATION NETWORKS  The effect of multipath on digital communications systems: With application to space station p 86 N87-22876 Integration of communications and tracking data processing simulation for space station p 115 N87-2590 Network reliability p 117 N87-29157  COMMUNICATION SATELLITES  Precise pointing control of flexible spacecraft p 55 A87-32446  Communication missions for geostationary platforms p 84 A87-34797  Modal-survey testing of the Olympus spacecraft p 152 A87-42666  Japan's space development programs for communications - An overview p 152 A87-43156  Evaluation of the infrared test method for the Olympus thermal balance tests p 44 A87-46682  Comparison of different attitude control schemes for large communications satellites [AIAA PAPER 87-2391] p 61 A87-50475  Dynamic analysis of direct TV-SAT/TDE-1 Modal testing of the Olympus development model stowed solar array Plans for industrialization of space discussed p 157 N87-21979  On the possibility of a several-kilovolt differential charge
CIRCULAR PLATES Vibrations and structureborne noise in space station [NASA-CR-181381] P 39 N87-29590  CIRCULARION Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces CIVIL AVIATION Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] P 171 N87-22697  CLOSED CYCLES Air Evaporation closed cycle water recovery technology - Advanced energy saving designs [SAE PAPER 860987] SAE PAPER 860987] SAE PAPER 860999] Vater recycling for Space Station CLOSED ECOLOGICAL SYSTEMS Water recycling for Space Station SAE PAPER 860997] Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] P 154 A87-49967 Electrochemical processing of solid waste	implications p 166 A87-32460  The Industrial Space Facility p 167 A87-38579  COMMUNICATION NETWORKS  The effect of multipath on digital communications systems: With application to space station p 86 N87-22876 Integration of communications and tracking data processing simulation for space station p 115 N87-25890  Network reliability p p 117 N87-259157  COMMUNICATION SATELLITES  Precise pointing control of flexible spacecraft p 55 A87-32446  Communication missions for geostationary platforms p 84 A87-34797  Modal-survey testing of the Olympus spacecraft p 152 A87-42266  Japan's space development communications - An overview p 152 A87-43166  Evaluation of the infrared test method for the Olympus thermal balance tests p 44 A87-46682  Comparison of different attitude control schemes for large communications satellites [AIAA PAPER 87-2391]  Dynamic analysis of direct TV-SAT/TDF-1  Modal testing of the Olympus development model stowed solar array Plans for industrialization of space discussed p 157 N87-21979

p 130 N87-25767

p 54 N87-29594

```
COMPARTMENTS
    Prototype thermal bus for manned Space Station
  compartments
  [SAE PAPER 861825]
COMPENSATORS
    Integrated control/structure design and robustness
COMPILERS
    Testing and analysis of DOD Ada language products
COMPLEX SYSTEMS
    Problems of mechanical system configuration control
COMPONENT RELIABILITY
    Evaluation testing of a mechanical actuator component
  operating in a simulated space environment
COMPOSITE MATERIALS
    International SAMPE Technical Conference, 18th,
   Seattle, WA, Oct. 7-9, 1986, Proceedings
    Assessment of space environment induced
  microdamage in toughened composite materials
    Use of lightweight composites for GAS payload p 25 N87-20307
    Dynamic analysis of the flexible boom in the N-ROSS
   satellite
  [AD-A181488]
     Effects on advanced materials: Results of the STS-8
   EOIM (Effects of Oxygen Interaction with Materials)
   experiment
   [AD-A182931]
COMPOSITE STRUCTURES
    Effect of transverse shearing forces on buckling and
   postbuckling of delaminated composites under compressive loads
   [AIAA PAPER 87-0877]
  Dynamic response of a viscoelastic Timoshenko beam [AIAA PAPER 87-0890] p 16 A87-33708
     Composite tubes for the Space Station truss structure
     Composite space antenna structures - Properties and
   environmental effects p 20 A87-38610

Measuring thermal expansion in large composite
   structures --- for spaceborne telescopes
   Composite fiber/metal Space Station tankage Applications, material/process/design trades, at
   subscale manufacturing/test results
   [AIAA PAPER 87-2157]
     Evaluation of the built-in stresses and residual distortions
   on cured composites for space antenna reflectors
   applications
     Stress and deformation analysis of lightweight
    composite structures --- space antennas
    MBB-UD-489/861
 COMPRESSION LOADS
    Effect of component compression on the initial performance of an IPV nickel-hydrogen cell [NASA-TM-100102] p 79 N87-24838
 COMPUTATION
    Modeling and computational algorithms for parameter 
estimation and optimal control of aeroelastic systems and
    large flexible structures
    [AD-A183302]
      Computational procedures for evaluating the sensitivity
    derivatives of vibration frequencies and Eigenmodes of
    framed structures
    [NASA-CR-4099]
  COMPUTATIONAL CHEMISTRY
      Potential energy surfaces for atomic oxygen reactions:
    Formation of singlet and triplet biradicals as primary
    reaction products with unsaturated organic molecules
      Potential surfaces for O atom-polymer reactions
  COMPUTATIONAL GRIDS
      Radiation heat transfer calculations for space
    structures
      AIAA PAPER 87-1522] p 44 A87-44830
An overview of controls research on the NASA Langley
essearch Center grid p 66 N87-22720
    [AIAA PAPER 87-1522]
    Research Center grid
  COMPUTER AIDED DESIGN
      ASTROS - A multidisciplinary automated structura
```

design tool

optimization

A quantitative comparison of several orbital maneuvering

ehicle configurations for satellite repair/replenishment

[AD-A179106]

p 161 N87-23677

[AIAA PAPER 87-0713]

A hybrid nonlinear programming method for design ptimization p 7 A87-35718
Gradient-based combined structural and control ptimization p 21 A87-40866
Interdisciplinary analysis procedures in the control of the control of

Interdisciplinary analysis procedures in the modeling and

control of large space-based structures

p 6 A87-33557

[NASA-CR-177447]

INASA-CR-1750931

Space station propulsion-ECLSS interaction study

COL	MPI I	TER	GR/	<b>APHI</b>	CS

Engineering graphics and image processing at Langley Research Center p 10 N87-29129

### **COMPUTER NETWORKS**

MPUTER NETWORKS
Network operating system focus technology
p 117 N87-29167

### **COMPUTER PROGRAM INTEGRITY**

Automated software production [AIAA PAPER 87-2219]

p 2 A87-48601

### COMPUTER PROGRAMMING

Automated software production

[AIAA PAPER 87-2219] p 2 A87-48601 Testing and analysis of DOD Ada language products

for NASA p 172 N87-29155

#### COMPUTER PROGRAMS

MOVER II - A computer program for verifying reduced-order models of large dynamic systems [SAE PAPER 861790] p 5 A87-32639

ASTROS - A multidisciplinary automated structural design tool

[AIAA PAPER 87-0713]

p 6 A87-33557

Practical implementation of an accurate method for multilevel design sensitivity analysis

p 6 A87-33560 [AIAA PAPER 87-0718] Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical

p.8 N87-20581 The multi-disciplinary design study. A life cycle cost algorithm

[NASA-CR-178192]

p 9 N87-21995

Microprocessor controlled proof-mass actuator

p 65 N87-22706

Box truss antenna technology status

p 87 N87-24503 Development of a computer program to generate typical measurement values for various systems on a space p 115 N87-26698

Computer modeling of high-voltage solar array experiment using the NASCAP/LEO (NASA Charging Analyzer Program/Low Earth Orbit) computer code [AD-A182589] p 81 N87-28186

SS focused technology: Gateways and NOS's p 117 N87-29165

## COMPUTER SYSTEMS DESIGN

Data capture and processing --- for Space Station

[AIAA PAPER 87-2203] AIAA PAPER 87-2203] p 113 A87-48588 Standards for the user interface - Developing a user consensus --- for Space Station Information System

AIAA PAPER 87-2209] p 169 A87-48594 Attitude and Orientation System (AOCS) tasks on [AIAA PAPER 87-2209] Rendezvous and Docking (RVD) (docking-undocking phases). Architecture of the whole simulator, volume 2 [LP-RP-AI-204-VOL-2]

Data management system architecture options for space stations --- Columbus project

[SES/DNP/TR/002/85] p 115 N87-28585 Study of data management system architecture options for space station --- Columbus project

[MATRA-RF/176/0932-ISS-1] p 115 N87-28586 A workstation environment for software engineering

p 116 N87-29128 Advanced software tools space station focused station focused p 5 N87-29164 technology Network operating system focus technology

### COMPUTER SYSTEMS PERFORMANCE N87-29167

On the performance analysis of a real-time distributed computer system omputer system p 111 A87-31518 Space station data management system - A common GSE test interface for systems testing and verification

p 112 A87-37294 Attitude and Orientation Control System (AOCS) tasks on Rendezvous and Docking (RVD) (docking-undocking phases). Simulation set-up and results, volume 3 p 69 N87-24491

### [LP-RP-AI-204-VOL-3] COMPUTER SYSTEMS PROGRAMS

The Space Station software support environment - Not just what, but why

[AIAA PAPER 87-2208] Standards for the user interface - Developing a user consensus --- for Space Station Information System

[AIAA PAPER 87-2209] p 169 A87-48594 TAE Plus: A conceptual view of TAE in the space station p 9 N87-23157 SOT: A rapid prototype using TAE windows

#### p 114 N87-23161 **COMPUTER TECHNIQUES**

Developing a voice-controlled, computer-generated display to assist space station astronauts during maintenance activity AD-A178997] p 120 N87-22762

### COMPUTER VISION

Optical correlator use at Johnson Space Center p 59 A87-42655

#### COMPUTERIZED SIMULATION

On the payload-tether technology providing the microgravity circumstances in the proximity of the Space p 122 A87-32533 Computer simulation of on-orbit manned maneuvering

unit operations [SAE PAPER 861783] p 47 A87-32632

Some approximations for the dynamics of spacecraft [AIAA PAPER 87-0821] p 122 A87-33687 Evaluation of constraint stabilization procedures for

multibody dynamical systems [AIAA PAPÉR 87-0927] p 7 A87-33728 Real-time simulation for Space Station

p 7 A87-37298 Orbital modifications using forced tether-length p 124 A87-40858 variations

Orbital debris environment resulting from future activities p 139 A87-44392 On the inadequacies of current multi-flexible body

simulation codes [AIAA PAPER 87-2248] p 7 A87-50412 A laboratory simulation of flexible spacecraft control [AIAA PAPER 87-2325] p 24 A87-50446

Temperature fields due to jet induced mixing in a typical OTV tank [AIAA PAPER 87-2017] p 93 A87-52247

Structural/control interaction (payload pointing and p 9 N87-22721 micro-a) Impact of space station appendage vibrations on the pointing performance of gimballed payloads

p 32 N87-22733
TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction

p 9 N87-22735 High speed simulation of flexible multibody dynamics

p 33 Attitude and Orientation Control System (AOCS) tasks on Rendezvous and Docking (RVD) (docking-undocking phases). Simulation set-up and results, volume 3

[LP-RP-AI-204-VOL-3] p 69 N87-24491 Integration of communications and tracking data processing simulation for space station

p 115 N87-25890 Development of a computer program to generate typical measurement values for various systems on a space p 115 N87-26698 Development of an emulation-simulation thermal control

model for space station application [NASA-CR-180312] p 45 N87-26936 Computer simulation of a rotational single-element

flexible spacecraft boom [AD-A181798] p 103 N87-26968 Computer modeling of high-voltage solar array experiment using the NASCAP/LEO (NASA Charging

Analyzer Program/Low Earth Orbit) computer code p 81 N87-28186 [AD-A1825891 Computer simulation of deployment --- solar arrays

p 10 N87-29002 Investigation of plasma contactors for use with orbiting

[NASA-CR-181422] p 131 N87-29591 CONCENTRATORS

p 82 N87-28977 GaAs concentrator solar arrays CONDENSATION Mixing-induced ullage condensation and fluid

destratification [AIAA PAPER 87-2018] p 92 A87-45357 Mixing-induced fluid destratification and ullage p 95 N87-21149

### **CONDENSERS (LIQUEFIERS)**

High thermal capacity evaporator and condensers for Space Station thermal control p 41 A87-32377 CONFERENCES

International Symposium on Space Technology and Science, 15th, Tokyo, Japan, May 19-23, 1986, Proceedings. Volumes 1 & 2 p 166 A87-32276 Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 p 55 A87-32726 Human Factors Society, Annual Meeting, 30th, Dayton,

OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001

Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987, Technical p 13 A87-33551 Papers, Part 1

Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Parts 2A & 2B

p 15 A87-33654 Computerized aerospace materials data; Proceedings of the Workshop on Computerized Property Materials and Design Data for the Aerospace Industry, El Segundo, CA, p 111 A87-35282 June 23-25, 1986

Tethers in space; Proceedings of the International Conference, Arlington, VA, Sept. 17-19, 1986

p 123 A87-38567 International SAMPE Technical Conference, 18th, Seattle, WA, Oct. 7-9, 1986, Proceedings

p 167 A87-38576 Aerospace environmental systems; Proceedings of the Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986 (SAE P-177)

p 162 A87-38701 on Microgravity Fluid Mechanics, Symposium Proceedings of the Winter Annual Meeting, Anaheim, CA, Dec. 7-12, 1986 p 89 A87-38785 U.S. National Congress of Applied Mechanics, 10th, University of Texas, Austin, June 16-20, 1986, Proceedings

p 1 A87-40051 EASCON '86; Proceedings of the Nineteenth Annual Electronics and Aerospace Systems Conference, Washington, DC, Sept. 8-10, 1986 p 2 A87-40351 Space: New opportunities for all people; Selected Proceedings of the Thirty-seventh International Astronautical Congress, Innsbruck, Austria, Oct. 4-11, p 168 A87-41568 P 168 A87-41568 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986

[SPIE-644] p 125 A87-44176 GLOBECOM '86 - Global Telecommunications Conference, Houston, TX, Dec. 1-4, 1986, Conference Record. Volumes 1, 2, & 3

AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers.

Volumes 1 & 2 p 60 A87-50401 The human quest in space; Proceedings of the Twenty-fourth Goddard Memorial Symposium, Greenbelt,

MD, Mar. 20, 21, 1986 p 2 A87-53082 Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529]

p 26 N87-20355 The Shock and Vibration Bulletin. Part 1: Welcome, Invited Papers, Shipboard Shock, Blast and Ground Shock, Shock Testing and Analysis p 29 N87-20574 [AD-A175224]

Proceedings of the European Symposium on Polar platform Opportunities and Remote-Sensing (ESPOIR) Instrumentation [ESA-SP-266] p 128 N87-20621

Microgravity Fluid Management Symposium p 94 N87-21141 [NASA-CP-2465] Structural Dynamics and Control Interaction of Flexible

[NASA-CP-2467-PT-2] p 66 N87-22729 Proceedings of the Second International Symposium on Spacecraft Flight Dynamics

p 171 N87-25354 [ESA-SP-255] Proceedings of the NASA Workshop on Atomic Oxygen Effects --- low earth orbital environment

p 141 N87-26173 [NASA-CR-181163] The Aerospace Environment at High Altitudes and its Implications for Spacecraft Charging Communications

[AGARD-CP-406] p 142 N87-26937 Proceedings of the Fifth European Symposium on Photovoltaic Generators in Space p 81 N87-28959

### CONFIGURATION MANAGEMENT

Problems of mechanical system configuration control p 149 A87-35877 The design and development of a two-dimensional p 40 N87-29860 adaptive truss structure

CONGRESSIONAL REPORTS

Department of Housing and Urban Development-independent agencies appropriations for

[GPO-73-418] p 171 N87-22560 National Aeronautics and Space Administration

Authorization Act [S-REPT-100-87] p 171 N87-24240 National Aeronautics and Space Administration Authorization Act, fiscal year 1988

[H-REPT-100-204] p 171 N87-25024 National Aeronautics and Space Administration

p 172 N87-30220 NASA authorization: Authorization of appropriations for the National Aeronautics and Space Administration for fiscal year 1988

[GPO-73-245] CONNECTORS

p 172 N87-30221

Collect lock joint for space station truss

p 36 N87-25576 [NASA-CASE-MSC-21207-1] Development of a standard connector for orbital replacement units for serviceable spacecraft p 40 N87-29864

### CONSTRAINTS

Structural optimization with frequency constraints [AIAA PAPER 87-0787] p 13 A87-33588

p 48 A87-38730

Status of the Space Station environmental control and

life support system design concept

CONSTRUCTION MATERIALS	Space station control moment gyro control	Status of the Space
Structures, Structural Dynamics and Materials	p 64 N87-20669	life support system des [SAE PAPER 860943]
Conference, 28th, Monterey, CA, Apr. 6-8, 1987, Technical	CONTROL SIMULATION	Nuclear powered su
Papers. Part 1 p 13 A87-33551	A laboratory simulation of flexible spacecraft control	A comparison of ECLS
CONTACTORS	[AIAA PAPER 87-2325] p 24 A87-50446 Control/dynamics simulation for preliminary Space	[SAE PAPER 860945]
Hollow cathode-based plasma contactor experiments for	Station design	Evaluation of Sp
electrodynamic tether [AIAA PAPER 87-0572] p 121 A87-32192	[AIAA PAPER 87-2641] p 61 A87-50486	techniques
Theory of plasma contactors for electrodynamic tethered	Flexible spacecraft simulator p 31 N87-22718	[SAE PAPER 860998]
satellite systems p 85 A87-41609	Attitude and Orientation System (AOCS) tasks on	Variable structure
Investigation of plasma contactors for use with orbiting	Rendezvous and Docking (RVD) (docking-undocking	nutation damping Soft mounted mome
wires	phases). Architecture of the whole simulator, volume 2	for the Space Shuttle (
[NASA-CR-181422] p 131 N87-29591	[LP-RP-AI-204-VOL-2] p 68 N87-24490	Space station active
CONTINUUM MECHANICS  An equivalent continuum analysis procedure for Space	Attitude and Orientation Control System (AOCS) tasks on Rendezvous and Docking (RVD) (docking-undocking	[AIAA PAPER 87-1468
Station lattice structures	phases). Simulation set-up and results, volume 3	Flexible system mod
[AIAA PAPER 87-0724] p 13 A87-33564	[LP-RP-AI-204-VOL-3] p 69 N87-24491	design based upon
Modeling and control of flexible structures	Attitude and Orientation Control System (AOCS) tasks	functions
[AD-A177106] p 29 N87-21388	on Rendezvous and Docking (RVD) (docking-undocking	Active vibration contr a spatially distributed a
Equivalent beam modeling using numerical reduction	phases). Docking-undocking phase analysis	Construction of po
techniques p 32 N87-22725	[LP-RP-Al-204-VOL-1] p 70 N87-24514 Dynamics of an actively controlled flexible Earth	control applied to L
Spectral factorization and homogenization methods for	observation satellite p 71 N87-25356	[AIAA PAPER 87-2238
modeling and control of flexible structures [AD-A179726] p 35 N87-24517	Active vibration damping of flexible structures using the	Control of distri
CONTINUUM MODELING	traveling wave approach p 71 N87-25360	nonproportional dampi
Reduced modeling and analysis of large repetitive space	Automatic docking maneuver and attitude control s	[AIAA PAPER 87-2250
structures via continuum/discrete concepts	ystem p 71 N87-25395	The control of ling structures
p 19 A87-35327	CONTROL STABILITY	[AIAA PAPER 87-2251
Determination of the natural frequencies of the	Robustness optimization of structural and controller	Robust control of a
longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121	parameters [AIAA PAPER 87-0791] p 14 A87-33591	[AIAA PAPER 87-2250
attached rigid bodies p 152 A87-46121 Wave propagation in transversely isotropic continuum	[AIAA PAPER 87-0791] p 14 A87-33591 Commit your works to the Lord, and your thoughts shall	Active damping cont
models of LSS (Large Space Structures)	be established (Prov. 16:3). Inter-stable control systems	System Control of
[AD-A177271] p 30 N87-22256	p 9 N87-22716	NASA
CONTRACTS	Improving stability margins in discrete-time LQG	[AIAA PAPER 87-2321 A laboratory simula
Space Station business p 169 A87-47726	controllers p 31 N87-22719	(AIAA PAPER 87-232
CONTROL	NASA/DOD Control/Structures Interaction Technology,	The mission function
Japanese Experiment Module (JEM) preliminary design	1986 [NASA-CP-2447-PT-2] p 34 N87-24495	of subsatellite
status p 151 A87-41570	[NASA-CP-2447-PT-2] p 34 N87-24495 Joint Optics Structures Experiment (JOSE)	[AIAA PAPER 87-2326
CONTROL CONFIGURED VEHICLES  Control operations in advanced aerospace systems	p 34 N87-24497	Reduced-order com
p 54 A87-32117	Experiences of CNES and SEP on space mechanisms	optimal projection
An assessment of recent advances in modeling and	rotating at low speed p 104 N87-29868	(AIAA PAPER 87-238 An Al-based mod
control design of space structures under uncertainty	CONTROL SYSTEMS DESIGN	structure control
[SAE PAPER 861818] p 147 A87-32655	Robust controller design using frequency domain constraints p 11 A87-32229	[AIAA PAPER 87-245
Integrated control/structure design and robustness [SAF PAPER 861821] p 6 A87-32657	constraints p 11 A87-32229  Robust controller synthesis for a large flexible space	Linear quadratic con
[SAE PAPER 861821] p 6 A87-32657 Static shape control for flexible structures	antenna p 84 A87-32235	pointed payloads
[SAE PAPER 861822] p 13 A87-32658	Configuration tradeoffs for the space infrared telescope	[AIAA PAPER 87-253
Vibration suppression using a constrained rate-feedback	facility pointing control system p 121 A87-32236	Model reference a
Threshold control strategy for large space structures	Transient dynamics of orbiting flexible structural	systems  Reposite of passive
[AIAA PAPER 87-0741] p 6 A87-33665	members p 54 A87-32338	Benefits of passive of large space structu
Structural and control optimization of space structures	High thermal capacity evaporator and condensers for Space Station thermal control p 41 A87-32377	Multi-axis vibration
[AIAA PAPER 87-0939] p 17 A87-33737	Space Station thermal control p 41 A87-32377  Local control for large space structures	exciters
An approach to structure/control simultaneous optimization for large flexible spacecraft	p 54 A87-32440	Variable structure
p 22 A87-46793	Two-time-scale design of robust controllers for large	spacecraft
Effects of atmosphere on slewing control of a flexible	structure systems p 12 A87-32443	Integrated control/s
structure p 22 A87-47809	Vibration control for a linked system of flexible	Otherstand Demander
Robust multivariable control of large space structures	structures p 55 A87-32444	Structural Dynamics Structures
using positivity p 59 A87-47810	Precise pointing control of flexible spacecraft	[NASA-CP-2467-PT-1
CONTROL EQUIPMENT	p 55 A87-32446	Status of the Mast
An integrated analytic tool and knowledge-based system	Control of a flexible space manipulator p 99 A87-32449	Large space structu
approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579	An integrated analytic tool and knowledge-based system	- '
Maintenance components for Space Station long life	approach to aerospace electric power system control	Identification of
fluid systems	[SAE PAPER 861622] p 74 A87-32579	state-of-practice repo
[SAE PAPER 861005] p 89 A87-38778	Integrated control/structure design and robustness	A general method overview
Control/monitor instrumentation for environmental	[SAE PAPER 861821] p 6 A87-32657	Space Station/St
control and life support systems aboard the Space	The Softmounted Inertially Reacting Pointing System	docking
Station [SAF PAPER 861007] p 52 A87-38779	(SIRPNT) [AAS PAPER 86-007] p 56 A87-32732	One Controller at
[SAE PAPER 861007] p 52 A87-38779 Status report and preliminary results of the spacecraft	Space Infrared Telescope Facility/Multimission Modular	methodology
control laboratory experiment p 66 N87-22717	Spacecraft Attitude Control System conceptual design	Commit your works
End effector development study. Volume 2: Service End	[AAS PAPER 86-031] p 56 A87-32736	be established (Prov.
Effector subsystem specification (SEESSPEC)	Laser docking system flight experiment	Status report and p
in-orbiting servicing	[AAS PAPER 86-043] p 99 A87-32745	control laboratory exp
[FOK-TR-R-86-091-VOL-2] p 102 N87-24486	Control augmented structural synthesis with transient	An overview of con
End effector development study, volume 1 in-orbit	response constraints [AIAA PAPER 87-0749] p 56 A87-33573	Research Center grid
servicing [FOK-TR-R-86-091-VOL-1] p 102 N87-25336	Simultaneous structure/control optimization of large	Solar array flight dy
End effector development study. Volume 3: Appendices	flexible spacecraft	
in-orbit servicing	[AIAA PAPER 87-0823] p 14 A87-33610	Precision pointing a
[FOK-TR-R-86-091-VOL-3] p 102 N87-25337	A comparison of active vibration control techniques -	
CONTROL MOMENT GYROSCOPES	Output feedback vs optimal control	Dual keel space s
A highly adaptable steering/selection procedure for	[AIAA PAPER 87-0904] p 56 A87-33713	study
combined CMG/RCS spacecraft control	Accuracy of derivatives of control performance using a	High speed simulat
[AAS PAPER 86-036] p 56 A87-32741	reduced structural model [AIAA PAPER 87-0905] p 57 A87-33714	
Proposed CMG momentum management scheme for	[AIAA PAPER 87-0905] p 57 A87-33/14  Shuttle orbit flight control design lessons - Direction for	Lanczos modes fe
space station [AIAA PAPER 87-2528] p 62 A87-50531	Space Station p 58 A87-37295	structures
Adaptive momentum management for the dual keel	System aspects of Columbus thermal control	Slewing control exp
Space Station	[SAE PAPER 860938] p 150 A87-38727	= :
[AIAA PAPER 87-2596] p 62 A87-50558	Space Station environmental control and life support	Maximum Entropy/

system distribution and loop closure studies

[SAE PAPER 860942]

p 48 A87-38729

tradeoffs

Nuclear powered submarines and the Space Station -A comparison of ECLSS requirements p 48 A87-38732 [SAE PAPER 860945] Evaluation of Space Station thermal control [SAE PAPER 860998] p 42 A87-38775 Variable structure controller design for spacecraft p 58 A87-39958 nutation damping Soft mounted momentum compensated pointing system p 59 A87-42817 for the Space Shuttle Orbiter Space station active thermal control system modelling p 43 A87-43003 [AIAA PAPER 87-1468] Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 Active vibration control of a simply supported beam using spatially distributed actuator p 23 A87-50232 Construction of positive real compensation for LSS a spatially distributed actuator control --- applied to Large Space Structure model [AIAA PAPER 87-2238] p 60 A87-50404 Control of distributed nonproportional damping structures with [AIAA PAPER 87-2250] p 60 A87-50414 The control of linear dampers for large space structures p 60 A87-50415 [AIAA PAPER 87-2251] Robust control of a large space antenna p 86 A87-50417 [AIAA PAPER 87-2253] Active damping control design for the COFS Mast Flight System --- Control of Flexible Structures program for [AIAA PAPER 87-2321] p 23 A87-50442 A laboratory simulation of flexible spacecraft control [AIAA PAPER 87-2325] p 24 A87-50446 The mission function control for deployment and retrieval of subsatellite [AIAA PAPER 87-2326] p 126 A87-50447 Reduced-order compensation - LQG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 An Al-based model-adaptive approach to flexible structure control
[AIAA PAPER 87-2457] p 61 A87-50503 Linear quadratic control system design for Space Station pointed payloads [AIAA PAPER 87-2530] p 161 A87-50533 Model reference adaptive control for large structural p 63 A87-52973 systems Benefits of passive damping as applied to active control p 63 N87-20371 of large space structures Multi-axis vibration tests on spacecraft using hydraulic p 8 N87-20373 Variable structure control system maneuvering of p 64 N87-21989 Integrated control/structure design and robustness p 65 N87-22060 Structural Dynamics and Control Interaction of Flexible Structures [NASA-CP-2467-PT-1] p 65 N87-22702 Status of the Mast experiment p 30 N87-22703 Large space structures ground experiment checkout p 30 N87-22704 structures: Identification of large p 31 N87-22705 state-of-practice report A general method for dynamic analysis of structures p 31 N87-22707 overview Station/Shuttle Orbiter dynamics during p 65 N87-22708 docking p 65 N87-22708 One Controller at a Time (1-CAT): A mimo design p 65 N87-22715 methodology Commit your works to the Lord, and your thoughts shall be established (Prov. 16:3). Inter-stable control systems p 9 N87-22716 Status report and preliminary results of the spacecraft p 66 N87-22717 control laboratory experiment An overview of controls research on the NASA Langley Research Center grid p 66 N87-22720 Solar array flight dynamic experiment p 78 N87-22722 Precision pointing and control of flexible spacecraft p 66 N87-22723 Dual keel space station control/structures interaction p 67 N87-22737 study High speed simulation of flexible multibody dynamics p 33 N87-22738 Lanczos modes for reduced-order control of flexible p 33 N87-22739 Slewing control experiment for a flexible panel p 78 N87-22740

Maximum Entropy/Optimal Projection (MEOP) control

p 9 N87-22741

design synthesis. Optimal quantification of the major design

[AIAA PAPER 87-2596]

Space station momentum management

p 64 N87-20668

Space station structures and dynamics test program	The dynamics and control of large flexible space	System technology analysis of aeroassisted orbital
p 33 N87-22751 Space station structural dynamics/reaction control	structures X, part 1 [NASA-CR-181287] p 73 N87-27712	transfer vehicles: Moderate lift/drag (0.75-1.5). Volume 3:
system interaction study p 67 N87-22753	CONTROLLERS	Cost estimates and work breakdown structure/dictionary, phase 1 and 2
Modified independent modal space control method for	Robustness optimization of structural and controller	[NASA-CR-179144] p.3 N87-26064
active control of flexible systems	parameters	COSTS
NASA-CH-181065 p 34 N87-23980 NASA/DOD Control/Structures Interaction Technology,	[AIAA PAPER 87-0791] p 14 A87-33591 Control of robot manipulator compliance	High power/large area PV systems
1986	p 100 A87-45797	COUPLED MODES p 80 N87-26452
[NASA-CP-2447-PT-2] p 34 N87-24495	Robust multivariable control of large space structures	The effect of circumferential aerodynamic detuning on
Joint Optics Structures Experiment (JOSE)	using positivity p 59 A87-47810	coupled bending-torsion unstalled supersonic flutter
p 34 N87-24497 Large spacecraft pointing and shape control	An Al-based model-adaptive approach to flexible structure control	[ASME PAPER 86-GT-100] p 166 A87-25396 A comparison between IMSC, PI and MIMSC methods
p 69 N87-24498	[AIAA PAPER 87-2457] p 61 A87-50503	in controlling the vibration of flexible systems
Robust control for large space antennas	Active structural controllers emulating structural	[NASA-CR-181156] p 36 N87-25605
p 87 N87-24499	elements by ICUs p 27 N87-20367	COUPLINGS
Large space systems technology and requirements	Multi-axis vibration tests on spacecraft using hydraulic exciters p 8 N87-20373	Preloaded space structural coupling joints [NASA-CASE-LAR-13489-1] p 38 N87-27713
p 3 N87-24500 Control technology overview in CSI	Integrated control/structure design and robustness	CRATERING
p 69 N87-24507	p 65 N87-22060	Expected size of a crater resulting from the impact of a micrometeorite p 119 A87-41870
Antenna Technology Shuttle Experiment (ATSE)	One Controller at a Time (1-CAT): A mimo design	a micrometeorite p 119 A87-41870 CREW WORKSTATIONS
p 87 N87-24508 Sampled nonlinear control for large angle maneuvers	methodology p 65 N87-22715 Electrodynamic tether p 131 N87-26449	Space Station galley design
of flexible spacecraft p 71 N87-25358	Digital control system for space structure dampers	[SAE PAPER 860932] p 119 A87-38722
A method of variable spacing for controlled plant growth	[NASA-CR-181253] p 72 N87-27704	A maintenance work station for Space Station [SAE PAPER 860933] p 167 A87-38723
systems in spaceflight and terrestrial agriculture applications	CONVERGENCE	[SAE PAPER 860933] p 167 A87-38723 CREWS
[NASA-CR-177447] p 130 N87-25767	Modeling and control of flexible structures	A systems analysis of emergency escape and recovery
Control engineering tasks in the framework of the	p 28 N87-20564 COOLANTS	systems for the US space station [AD-A179233] p.3 N87-23680
Columbus program	Superfluid helium on orbit transfer (SHOOT)	CRUISING FLIGHT p 3 N87-23680
[MBB-UR-E-912/86] p 158 N87-26842 Study on investigation of the attitude control of large	p 95 N87-21151	Optimal heading change with minimum energy loss for
flexible spacecraft. Phase 1, volume 1: Technical report	COOLING	a hypersonic gliding vehicle
[ESA-CR(P)-2361-VOL-1] p 73 N87-27706	Development of an emulation-simulation thermal control model for space station application	[AIAA PAPER 87-2568] p 136 A87-49618 Optimal nodal transfer and aeroassisted transfer by
Study on investigation of the attitude control of large flexible spacecraft, phase 3	[NASA-CR-181221] p 45 N87-27702	aerocruise p 138 N87-28577
[ESA-CR(P)-2361-VOL-4] p 73 N87-27709	COORDINATES	CRYOGENIC COOLING
CONTROL THEORY	Wave-mode coordinates and scattering matrices for	Magnetic refrigeration for space platforms [SAE PAPER 861724] p 118 A87-32613
Low-authority control through passive damping [AAS PAPER 86-004] p 55 A87-32730	wave propagation [AD-A176998] p 29 N87-21030	Microgravity fluid management requirements of
Modeling, stabilization and control of serially connected	COPOLYMERS	advanced solar dynamic power systems
beams p 21 A87-41052	Aromatic polyester polysiloxane block copolymers:	p 77 N87-21153 CRYOGENIC EQUIPMENT
Robust nonlinear attitude control of flexible spacecraft	Multiphase transparent damping materials [AD-A182623] p 110 N87-27809	Evaluation of cryogenic system test options for the OTV
p 60 A87-48273 The mission function control for deployment and retrieval	[AD-A182623] p 110 N87-27809  CORROSION PREVENTION	on-orbit propellant depot
of subsatellite	Oxidation protection coatings for polymers	[AIAA PAPER 87-1498] p 90 A87-43027
[AIAA PAPER 87-2326] p 126 A87-50447	[NASA-CASE-LEW-14072-3] p 107 N87-23736	CRYOGENIC FLUID STORAGE Thermodynamic analysis and subscale modeling of
Single-mode projection filters for identification and state estimation of flexible structures	CORROSION RESISTANCE	space-based orbit transfer vehicle cryogenic propellant
[AIAA PAPER 87-2387] p 24 A87-50471	Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642	resupply
Square root state estimator for large space structures	COSMIC BACKGROUND EXPLORER SATELLITE	[AIAA PAPER 87-1764] p 92 A87-48572 Advanced long term cryogenic storage systems
[AIAA PAPER 87-2389] p 24 A87-50473 An analytical and experimental investigation of output	Infra-red astronomy after IRAS p 127 A87-54197	p 94 N87-21142
feedback vs. linear quadratic regulator for large space	COSMIC DUST	Long term cryogenic storage facility systems study
structures	Micrometeorite impact on solar panels ESA telecommunication satellites p 82 N87-28981	p 94 N87-21143 Space station experiment definition: Long term cryogenic
[AIAA PAPER 87-2390] p 61 A87-50474 Benefits of passive damping as applied to active control	COSMIC RAYS	fluid storage p 94 N87-21144
of large space structures p 63 N87-20371	High energy gamma ray astronomy	Helium technology issues p 94 N87-21145
Air Force basic research in dynamics and control of	p 129 N87-24258 COSMONAUTS	Overview: Fluid acquisition and transfer p 94 N87-21146
large space structures p 63 N87-20577 OPUS: Optimal Projection for Uncertain Systems	Soviet space stations as analogs, second edition	The coupled dynamics of fluids and spacecraft in low
[AD-A176820] p 29 N87-21025	[NASA-CR-180920] p 157 N87-21996	gravity and low gravity fluid measurement
Modeling and control of flexible structures	COST ANALYSIS	p 94 N87-21147 Numerical modelling of cryogenic propellant behavior
[AD-A177106] p 29 N87-21388 A quasi-analytical method for non-iterative computation	Commercialization of space - The insurance implications p 166 A87-32460	in low-G p 95 N87-21148
of nonlinear controls p 66 N87-22731	A model for the estimation of the operations and	Mixing-induced fluid destratification and ullage
Control of flexible structures and the research	utilisation costs of an international space station	condensation p 95 N87-21149 Cryogenic Fluid Management Flight Experiment
community p 66 N87-22732  Maneuvering and vibration control of flexible	p 168 A87-42267	(CFMFE) p 95 N87-21150
spacecraft p 67 N87-22734	Satellite servicing mission preliminary cost estimation model	Superfluid helium on orbit transfer (SHOOT)
A TREETOPS simulation of the Hubble Space	[NASA-CR-171978] p 136 N87-20335	p 95 N87-21151 Microgravity fluid management in two-phase thermal
Telescope-High Gain Antenna interaction	Density uncertainty effect on cost of space station	systems p 95 N87-21152
p 9 N87-22735  Dual keel space station control/structures interaction	reboost p 170 N87-20667	Thermodynamic analysis and subscale modeling of
study p 67 N87-22737	The multi-disciplinary design study. A life cycle cost algorithm	space-based orbit transfer vehicle cryogenic propellant resupply
On the control of structures by applied thermal gradients	[NASA-CR-178192] p 9 N87-21995	[NASA-TM-89921] p 96 N87-22949
gradients p 33 N87-22747 Control technology overview in CSI	Design of a mixed fleet transportation system to low	Space station experiment definition: Long-term
p 69 N87-24507	Earth orbit. Volume 1: Executive summary. Volume 2: Near-term shuttle replacement. Volume 3: Heavy-lift cargo	cryogenic fluid storage [NASA-CR-4072] p 97 N87-24641
Suboptimal control of large flexible space structures	vehicle. Volume 4: Advanced technology shuttle	[NASA-CH-4072] p 97 N87-24641  Design and demonstrate the performance of cryogenic
experiencing rotational dynamics nonlinearities [AD-A180606] p 71 N87-25352	replacement p 5 N87-29583	components representative of space vehicles: Start basket
The effects of structural perturbations on decoupled	COST EFFECTIVENESS	liquid acquisition device performance analysis [NASA-CR-179138] p 97 N87-26081
control spacecraft p 35 N87-25359	20 kHz Space Station power system p 76 A87-40378	[NASA-CR-179138] p 97 N87-26081 CRYOGENIC FLUIDS
Minimum time attitude slewing maneuvers of a rigid spacecraft	A cost effective 300 Mbps space-to-ground	On-orbit cryogenic fluid management experimental data
[NASA-CR-181130] p 72 N87-26038	communications subsystem for the Space Station	requirements using referee fluids
Analytical investigation of the dynamics of tethered	program p 113 A87-45521 Leadership in space transportation	[AIAA PAPER 87-1559] p 90 A87-44832 Quick-disconnect inflatable seal assembly
constellations in Earth orbit, phase 2 [NASA-CR-179149] p 130 N87-26083	Leguership in Space transportation	
		[NASA-CASE-KSC-11368-1] p 102 N87-25583
Projection filters for modal parameter estimate for	p 170 A87-53989	CRYOGENIC ROCKET PROPELLANTS
Projection filters for modal parameter estimate for flexible structures	p 170 A87-53989  COST ESTIMATES  Concept design and cost estimation of a free-flying	CRYOGENIC ROCKET PROPELLANTS  Evaluation of cryogenic system test options for the OTV
flexible structures [NASA-CR-180303] p 38 N87-26583	p 170 A87-53989  COST ESTIMATES  Concept design and cost estimation of a free-flying space platform p 146 A87-32539	CRYOGENIC ROCKET PROPELLANTS  Evaluation of cryogenic system test options for the OTV on-orbit propellant depot  [AIAA PAPER 87-1498] p 90 A87-43027
flexible structures	p 170 A87-53989  COST ESTIMATES  Concept design and cost estimation of a free-flying	CRYOGENIC ROCKET PROPELLANTS  Evaluation of cryogenic system test options for the OTV on-orbit propellant depot

Thermodynamic analysis and subscale modeling of	DATA LINKS	Mass storage systems for data transport in the early
space-based orbit transfer vehicle cryogenic propellant	Antenna systems and RF coverage for the Space Station p 2 A87-45523	space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443
resupply [AIAA PAPER 87-1764] p 92 A87-48572	User interface and payload command and control	Flight array processor p 116 N87-29148
Long term cryogenic storage facility systems study	p 73 N87-29162	SS focused technology: Gateways and NOS's p 117 N87-29165
p 94 N87-21143 Numerical modelling of cryogenic propellant behavior	DATA MANAGEMENT Autonomous decentralized system concept for Space	DEBRIS
in low-G p 95 N87-21148	Station p 146 A87-32541	Simulation of on-orbit satellite fragmentations p 140 N87-24515
Thermodynamic analysis and subscale modeling of space-based orbit transfer vehicle cryogenic propellant	Japanese experiment module data management and communication system p 147 A87-32542	DECISION MAKING
resupply	Space Station data management system architecture	A multiple attribute decision analysis of manned airlock systems
[NASA-TM-89921] p 96 N87-22949  CURRENT DENSITY	p 111 A87-37293	[AD-A179241] p 137 N87-23682
Advanced fuel cell concepts for future NASA missions	Space station data management system - A common GSE test interface for systems testing and verification	DECOMPRESSION SICKNESS  Energy expenditure during simulated EVA workloads
p 99 N87-29930 CURRENT DISTRIBUTION	p 112 A87-37294	[SAE PAPER 860921] p 163 A87-38713
Space station electrical power distribution analysis using	Communication and Data Management Systems for an orbiting platform p 112 A87-40359	Hyperbaric oxygen therapy for decompression accidents - Potential applications to Space Station Operation
a load flow approach p 80 N87-26699  CYLINDRICAL BODIES	orbiting platform p 112 A87-40359 On board Data Management p 112 A87-40381	[SAE PAPER 860927] p 163 A87-38717
Dynamic and thermal response finite element models	Data management standards for space information	DEEP SPACE Present and future military uses of outer space:
of multi-body space structural configurations [NASA-CR-178289] p 10 N87-24709	systems [AIAA PAPER 87-2205] p 113 A87-48590	International law, politics, and the practice of states
CYLINDRICAL SHELLS	Evolution of data management systems from Spacelab	[AD-A176722] p 170 N87-21753 DEFENSE PROGRAM
Vibrations and structureborne noise in space station [NASA-CR-181381] p 39 N87-29590	to Columbus [AIAA PAPER 87-2227] p 154 A87-48605	National space transportation studies
[NASA-CH-161361] p 65 1107-25555	Payload data management scheme planned for Earth	[SAE PAPER 861681] p 160 A87-32598
D	observation sensors to be flown on the polar platforms in the framework of the space station/Columbus	DEFORMATION  Model study of simplex masts for space
_	program p 114 N87-20630	applications p 144 A87-32339
DAMAGE Arc propagation, emission and damage on spacecraft	Data management panel report Columbus polar platforms p 114 N87-20639	Dynamic and thermal effects in very large space structures p 25 N87-20347
dielectrics p 143 N87-26952	platforms p 114 N87-20639  Development of a computer program to generate typical	Dynamics of flexible structures performing large overall
DAMAGE ASSESSMENT On orbit damage assessment for large space	measurement values for various systems on a space	motions: A geometrically-nonlinear approach p 64 N87-21335
structures	station p 115 N87-26698  Data management system architecture options for space	Stress and deformation analysis of lightweight
[AIAA PAPER 87-0870] p 15 A87-33634	stations Columbus project	composite structures space antennas [MBB-UD-489/86] p 30 N87-22269
Degradation studies of SMRM teflon p 106 A87-38641	[SES/DNP/TR/002/85] p 115 N87-28585 Study of data management system architecture options	Evaluation of on-line pulse control for vibration
A proposal for space tether damage indication, location,	for space station Columbus project	suppression in flexible spacecraft [NASA-CR-180391] p 70 N87-24513
and evaluation - The Repair Monkey Module p 125 A87-43354	[MATRA-RF/176/0932-ISS-1] p 115 N87-28586 Proceedings: Computer Science and Data Systems	DEGRADATION
System identification for large space structure damage assessment p 33 N87-22750	Technical Symposium, volume 1	High intensity 5 eV CW laser sustained 0-atom exposure facility for material degradation studies
Assessment p 33 N87-22750  Space station integrated wall design and penetration	[NASA-TM-89285] p 116 N87-29124 Proceedings: Computer Science and Data Systems	p 105 A87-32060
damage control. Task 3: Theoretical analysis of penetration	Technical Symposium, volume 2	Selected materials issues associated with Space Station p 105 A87-32061
mechanics [NASA-CR-179166] p 39 N87-28582	[NASA-TM-89286] p 116 N87-29144 A VHSIC general purpose processor	Degradation studies of SMRM teflon
Space station integrated wall design and penetration	p 116 N87-29145	p 106 A87-38641 Future trends in spacecraft design and qualification
damage control. Task 4: Impact detection/location system	Testing and analysis of DOD Ada language products for NASA p 172 N87-29155	p 2 N87-20356
(NASA-CR-179167) p 4 N87-28583	DATA STORAGE	System identification for large space structure damage assessment p 33 N87-22750
Effects on advanced materials: Results of the STS-8 EOIM (Effects of Oxygen Interaction with Materials)	Data storage systems technology for the Space Station era	O-atom degradation mechanisms of materials
experiment	[AIAA PAPER 87-2202] p 113 A87-48587	p 141 N87-26178 Radiation charging and breakdown of insulators
[AD-A182931] p 110 N87-29709  DAMPERS	Mass storage systems for data transport in the early space station era 1992-1998	p 143 N87-26954
Digital control system for space structure dampers	[NASA-TM-87826] p 115 N87-27443	Oxygen interaction with space-power materials [NASA-CR-181396] p 132 N87-29633
[NAŠA-CR-181253] p 72 N87-27704  DAMPING	DATA SYSTEMS ESA's future integrated space data system	DEGREES OF FREEDOM
Notes on implementation of Coulomb friction in coupled dynamical simulations p 67 N87-22746	[AIAA PAPER 87-2190] p 153 A87-48578	Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547
dynamical simulations p 67 N87-22746 Aromatic polyester polysiloxane block copolymers:	Data capture and processing for Space Station [AIAA PAPER 87-2203] p 113 A87-48588	Application of a traction-drive 7-degrees-of-freedom
Multiphase transparent damping materials	The Consultative Committee for Space Data Systems	telerobot to space manipulation (DE87-004616) p 101 N87-22231
[AD-A182623] p 110 N87-27809 <b>DATA ACQUISITION</b>	Standards program [AIAA PAPER 87-2204] p 113 A87-48589	Suboptimal control of large flexible space structures
Process control and data acquisition for commercial	The Space Station software support environment - Not	experiencing rotational dynamics nonlinearities [AD-A180606] p 71 N87-25352
materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583	just what, but why [AIAA PAPER 87-2208] p 114 A87-48593	DELAMINATING
Data capture and processing for Space Station	Data management system architecture options for space	Effect of transverse shearing forces on buckling and postbuckling of delaminated composites under
[AIAA PAPER 87-2203] p 113 A87-48588 Remote Sensing Information Sciences Research Group:	stations Columbus project [SES/DNP/TR/002/85] p 115 N87-28585	compressive loads
Santa Barbara Information Sciences Research Group, year	Study of data management system architecture options	[AIAA PAPER 87-0877] p 105 A87-33639
4 [NASA-CR-181073] p 115 N87-24817	for space station Columbus project [MATRA-RF/176/0932-ISS-1] p 115 N87-28586	DEMULTIPLEXING  Fiber optics wavelength division
Development of a computer program to generate typical	Proceedings: Computer Science and Data Systems	multiplexing(components) p 117 N87-29151
measurement values for various systems on a space station p 115 N87-26698	Technical Symposium, volume 1 [NASA-TM-89285] p 116 N87-29124	DEPLOYMENT  Design consideration of mechanical and deployment
DATA BASE MANAGEMENT SYSTEMS	[NASA-TM-89285] p 116 N87-29124 Information network architectures p 116 N87-29149	properties of a coilable lattice mast p 12 A87-32340
Problems in merging Earth sensing satellite data sets [NASA-TM-87820] p 129 N87-22457	Fiber optics wavelength division multiplexing(components) p 117 N87-29151	Deployment dynamics of space structures p 58 A87-40074
Electronic control/display interface technology	multiplexing(components) p 117 N87-29151 Fiber optic data systems p 117 N87-29152	Computer simulation of deployment solar arrays
p 88 N87-29161 User data management p 4 N87-29163	Advanced local area network concepts	p 10 N87-29002 The extendable and retractable mast as supporting tool
Advanced software tools space station focused	p 117 N87-29153 SS focused technology: Gateways and NOS's	for rigid solar arrays p 39 N87-29012
technology p 5 N87-29164 Network operating system focus technology	p 117 N87-29165	The 21st Aerospace Mechanisms Symposium [NASA-CP-2470] p 103 N87-29858
p 117 N87-29167	KSC Space Station Operations Language (SSOL) p 138 N87-29168	Folding, articulated, square truss p 40 N87-29859
DATA BASES	DATA TRANSFER (COMPUTERS)	DERIVATION  Computational procedures for evaluating the sensitivity
Computerized aerospace materials data; Proceedings of the Workshop on Computerized Property Materials and	Mass storage systems for data transport in the early space station era 1992-1998	derivatives of vibration frequencies and Eigenmodes of
Design Data for the Aerospace Industry, El Segundo, CA,	[NASA-TM-87826] p 115 N87-27443	framed structures [NASA-CR-4099] p 40 N87-29899
June 23-25, 1986 p 111 A87-35282	DATA TRANSMISSION	[14/0/1-14088] p 40 1407-14088

Payload data management scheme planned for Earth observation sensors to be flown on the polar platforms in the framework of the space station/Columbus program p 114 N87-20630

DESIGN ANALYSIS

Practical implementation of an accurate method for multilevel design sensitivity analysis
[AIAA PAPER 87-0718] p 6 A87-33560

p 6 A87-33560

User data management

Development of metal matrix composites in R & D

p 4 N87-29163

Institute of Metals & Composites for Future Industries p 107 A87-51772

Thermal design of the ACCESS erectable space truss p 42 A87-34469 An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784 Composite fiber/metal Space Station tankage -Applications, material/process/design subscale manufacturing/test results [AIAA PAPER 87-2157] p 160 A87-45441 Control/dynamics simulation for preliminary Space Station design [AIAA PAPER 87-2641] p 61 A87-50486 Two-phase reduced gravity experiments for a space reactor design p 8 N87-21154 Maintenance evaluation for space station liquid systems p 52 N87-21155 The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995 Structural Dynamics and Control Interaction of Flexible p 66 N87-22729 [NASA-CP-2467-PT-21 A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p.3 N87-23680 Space station WP-04 power system. Volume 1: Executive summary [NASA-CR-179587-VOL-1] p 78 N87-23695 Space station WP-04 power system. Volume 2: Study p 79 N87-23696 Design, development and fabrication of a p 35 N87-25349 p 36 N87-25606 Shape design sensitivity analysis and optimal design of p 37 N87-26370 Design study of large area 8 cm x 8 cm wrapthrough ells for space station p 80 N87-26424 Space station integrated wall design and penetration p 39 N87-28581 Concept design and cost estimation of a free-flying p 146 A87-32539 A cost effective 300 Mbps p 113 A87-45521 The role of electronic mechanisms in surface erosion p 137 N87-26181 Expansion of space station diagnostic capability to p 53 N87-26703 Spacecraft dielectric material properties and spacecraft p 105 A87-33100 Arc propagation, emission and damage on spacecraft p 143 N87-26952 Automatic charge control system for geosynchronous p 87 N87-26960 Thick dielectric charging on high altitude spacecraft p 87 N87-26961 High energy gamma ray astronomy p 129 N87-24258

[NASA-CR-179587-VOL-2] deployable/retractable truss beam model for large space structures application [NASA-CR-178287] Preliminary design, analysis, and costing of a dynamic scale model of the NASA space station [NASA-CR-4068] structural systems INASA-CR-1810951 cells for space station damage control [NASA-CR-179165] DESIGN TO COST space platform A cost effective 300 Mbps space-to-ground communications subsystem for the Space Station program and glow phenomena include serological identification of viral and bacterial DIELECTRICS charging --- Book satellites DIFFUSE RADIATION **DIGITAL COMPUTERS** Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144 DIGITAL FILTERS Single-mode projection filters for identification and state estimation of flexible structures [AIAA PAPER 87-2387] p 24 A87-50471 DIGITAL SIMULATION The effect of nonlinearities on flexible structures p 38 N87-27259 DIGITAL SYSTEMS The effect of multipath on digital communications systems: With application to space station

Digital control system for space structure dampers

The use of multidimensional scaling for facilities layout

Critical length for stable elongated orbiting structures

- An application to the design of the Space Station

[AD-A178578]

[NASA-CR-181253]

DIMENSIONAL ANALYSIS

**DIMENSIONAL STABILITY** 

p 86 N87-22876

p 72 N87-27704

p 118 A87-33003

p 148 A87-32819

Measuring thermal expansion in large composite structures --- for spaceborne telescopes p 20 A87-38612 Dynamic and thermal effects in very large space DIRECTIONAL CONTROL SPOT/MEGS design and flight results obtained --- solar array drive (MEGS) p 103 N87-29009 DISCONNECT DEVICES Preloadable vector sensitive latch [NASA-CASE-MSC-20910-1] p 161 N87-25582 DISCRETE FUNCTIONS Reduced modeling and analysis of large repetitive space structures via continuum/discrete concepts p 19 A87-35327 DISPLACEMENT Response bounds for linear underdamped systems [ASME PAPER 87-APM-34] p 59 A87-42505 DISPLAY DEVICES Head-ported display analysis for Space Station applications p 111 A87-31463 Use of heads-up displays, speech recognition, and speech synthesis in controlling a remotely piloted space vehicle p 99 A87-31493 Developing a voice-controlled, computer-generated display to assist space station astronauts during maintenance activity [AD-A178997] p 120 N87-22762 Electronic control/display interface technology p 88 N87-29161 DISTORTION Hoop/column and tetrahedral truss electromagnetic DISTRIBUTED PARAMETER SYSTEMS
Control page 157 Control operations in advanced aerospace systems p 54 A87-32117 Dynamical response to pulse excitations in large space [AIAA PAPER 87-0710] Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE) [AIAA PAPER 87-0895] p 16 A87-33689 Sensitivity of distributed structures to model order in eedback control [AIAA PAPER 87-0900] p 56 A87-33710 Control of distributed structures with small nonproportional damping [AIAA PAPER 87-2250] p 60 A87-50414 Adaptive identification of flexible structures by lattice [AIAA PAPER 87-2458] p 24 A87-50504 On-line identification and attitude control for SCOLE [AIAA PAPER 87-2459] p 61 A87-50505 Distributed parameter modeling of the structural dynamics of the Solar Array Flight Experiment [AIAA PAPER 87-2460] p 25 A87-50506 Practical issues in computation of optimal, distributed control of flexible structures [AIAA PAPER 87-2461] p 25 A87-50507 Spectral factorization and homogenization methods for modeling and control of flexible structures p 35 N87-24517 [AD-A1797261 Development of intelligent structures using finite control elements in a hierarchic and distributed control system [AD-A179711] p 72 N87-25805 DISTRIBUTED PROCESSING On the performance analysis of a real-time distributed computer system p 111 A87-31518 Integration of communications and tracking data processing simulation for space station p 115 N87-25890 Proceedings: Computer Science and Data Systems Technical Symposium, volume 1 [NASA-TM-89285] p 116 N87-29124 Distributed computer taxonomy based on O/S p 116 N87-29127 structure Advanced local area network concepts p 117 N87-29153 Testing and analysis of DOD Ada language products p 172 N87-29155 Advanced software tools space station focused technology p 5 N87-29164 DOWNLINKING A cost effective 300 Mbps space-to-ground

communications subsystem for the Space Station p 113 A87-45521 Flight array processor p 116 N87-29148 DRAG Effects of atmosphere on slewing control of a flexible structure p 22 A87-47809 DROPS (LIQUIDS) Liquid droplet radiator development status --- waste heat rejection devices for future space vehicles [AIAA PAPER 87-1537] p 43 A87-43059

**DYNAMIC RESPONSE** Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 The liquid droplet radiator in space: A parametric [AD-A182605] p 46 N87-29217 DURABILITY A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 DWELL On sine dwell or broadband methods for modal testing [AIAA PAPER 87-0961] p 18 A87-33752 DYNAMIC CHARACTERISTICS Wave-mode coordinates and scattering matrices for wave propagation p 29 N87-21030 [AD-A176998] Dynamic finite element modeling of flexible structures p 30 N87-22252 [AD-A177168] Solar array flight dynamic experiment p 78 N87-22722 Dynamic characteristics of a vibrating beam with periodic variation in bending stiffness p 32 N87-22726 An integrated, optimization-based approach to the design and control of large space structures p 34 N87-23683 [AD-A179459] Suboptimal control of large flexible space structures experiencing rotational dynamics nonlinearities [AD-A180606] p 71 N87-25352 DYNAMIC CONTROL On the control of flexible structures by applied thermal aradients [AIAA PAPER 87-0887] p 16 A87-33706 Actuators for actively controlled space structures p 59 A87-42816 Effects of atmosphere on slewing control of a flexible structure p 22 A87-47809 Distributed parameter modeling of the structural dynamics of the Solar Array Flight Experiment p 25 A87-50506 [AIAA PAPER 87-2460] A computer program for model verification of dynamic p 31 N87-22710 svstems COFS 3 multibody dynamics and control technology p 69 N87-24506 Spectral factorization and homogenization methods for modeling and control of flexible structures [AD-A179726] p 35 N87-24517 Some problems in the control of large space structures [AD-A179989] p 70 N87-25350 DYNAMIC LOADS Box truss antenna technology status p 87 N87-24503 Contact dynamics math model [NASA-CR-179147] p 71 N87-25801 DYNAMIC MODELS Some approximations for the dynamics of spacecraft tethers [AIAA PAPER 87-0821] p 122 A87-33687 Dynamic analysis and experiment methods for a generic space station model p 22 A87-41613 Flexible system model reduction and control system design based upon actuator and sensor influence D 59 A87-46301 Wave propagation in transversely isotropic continuum models of LSS (Large Space Structures) [AD-A177271] p 30 N87-22256 Large space structures testing [NASA-TM-100306] p 35 N87-24520 Contact dynamics math model p 71 N87-25801 Thermal-electrical dynamical simulation of spacecraft p 83 N87-29004 solar array DYNAMIC RESPONSE Dynamical response to pulse excitations in large space structures [AIAA PAPER 87-0710] p 15 A87-33658 Dynamic response of a viscoelastic Timoshenko beam [AIAA PAPER 87-0890] p 16 A87-33708 p 16 A87-33708 Use of a video-photogrammetry system for the measurement of the dynamic response of the shuttle

remote manipulator arm

SAFE/DAE: Modal test in space

constellations in Earth orbit, phase 2

structures

satellite

[AD-A181488]

p 101 N87-20370

p 28 N87-20372 p 77 N87-20584

p 31 N87-22710

p 78 N87-22740

p 72 N87-26966

Acoustic effects on the dynamic of lightweight

A computer program for model verification of dynamic

Analytical investigation of the dynamics of tethered

[NASA-CR-179149] p 130 N87-26083 Dynamic analysis of the flexible boom in the N-ROSS

Slewing control experiment for a flexible panel

Orbital debris environment resulting from future activities a space p 139 A87-44392

		Notes on implementation of Coulomb friction in coupled
An experimental investigation of vibration suppression	The Shock and Vibration Bulletin. Part 1: Welcome,	dynamical simulations p 67 N87-22746
in large space structures using positive position	Invited Papers, Shipboard Shock, Blast and Ground Shock,	dynamical simulations p of the zero
feedback p 39 N87-28937	Shock Testing and Analysis [AD-A175224] p 29 N87-20574	_
DYNAMIC STABILITY	[	E
Instability of an elastic filament in orbit around a	Modal test and analysis: Multiple tests concept for	
gravitating center p 148 A87-32815	improved validation of large space structure mathematical	EARTH ALBEDO
On the dynamical stability of the space 'monorail'	models p 8 N87-20581	AMOC: An alternative module configuration for
p 148 A87-34047	SAFE/DAE: Modal test in space p 77 N87-20584	advanced solar arrays in low Earth orbits
The dynamics and control of large flexible space	The results of a limited study of approaches to the	p 159 N87-28968
structures X, part 1	design, fabrication, and testing of a dynamic model of the	EARTH IONOSPHERE
[NASA-CR-181287] p 73 N87-27712	NASA IOC space station. Executive summary	A preliminary study of extended magnetic field structures
DYNAMIC STRUCTURAL ANALYSIS	[NASA-CR-178276] p 8 N87-21020	in the ionosphere
Model study of simplex masts for space	Dynamics of flexible structures performing large overall	[NASA-CR-181004] p 140 N87-23066
applications p 144 A87-32339	motions: A geometrically-nonlinear approach	EARTH MAGNETOSPHERE
MOVER II - A computer program for verifying	p 64 N87-21335	The Aerospace Environment at High Altitudes and its
reduced-order models of large dynamic systems	Structural Dynamics and Control Interaction of Flexible	Implications for Spacecraft Charging and
[SAE PAPER 861790] p 5 A87-32639	Structures	Communications
A Lanczos eigenvalue method on a parallel computer	[NASA-CP-2467-PT-1] p 65 N87-22702	[AGARD-CP-406] p 142 N87-26937
for large complex space structure free vibration	A general method for dynamic analysis of structures	EARTH OBSERVATIONS (FROM SPACE)
analysis [AIAA PAPER 87-0725] p 13 A87-33565	overview p 31 N87-22707	A crisis in the NASA space and earth sciences
	Considerations in the design and development of a	programme p 112 A87-37968
Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA	space station scale model p 9 N87-22711	Proceedings of the European Symposium on Polar
Dynamics Specialists Conference, Monterey, CA, Apr. 9,	Precision pointing and control of flexible spacecraft	platform Opportunities and Instrumentation for
10, 1987, Technical Papers. Parts 2A & 2B	p 66 N87-22723	Remote-Sensing (ESPOIR)
p 15 A87-33654	Dynamics of trusses having nonlinear joints	[ESA-SP-266] p 128 N87-20621
Dynamical response to pulse excitations in large space	p 32 N87-22724	The Earth observation activities of the European Space
	Dynamic characteristics of a vibrating beam with periodic	Agency and the use of the polar platform of the International Space Station p 128 N87-20622
structures [AIAA PAPER 87-0710] p 15 A87-33658	variation in bending stiffness p 32 N87-22726	International Space Station p 128 N87-20622 Working group on Earth observation requirements for
Adaptive planar truss structures and their vibration	Structural dynamics system model reduction	Working group on Earth observation requirements for
characteristics	p 32 N87-22727	the Polar Orbiting Platform Elements of the International Space Station (the POPE Working Group)
[AIAA PAPER 87-0743] p 148 A87-33667	Structural Dynamics and Control Interaction of Flexible	p 128 N87-20625
High speed simulation of multi-flexible-body systems	Structures	Orbit configurations space station polar platform
with large rotations	[NASA-CP-2467-PT-2] p 66 N87-22729	p 156 N87-20629
[AIAA PAPER 87-0930] p 57 A87-33730	Vibration suppression by stiffness control	Payload data management scheme planned for Earth
Dynamic and attitude control characteristics of an	p 66 N87-22730	observation sensors to be flown on the polar platforms
International Space Station	Preliminary evaluation of a reaction control system for	in the framework of the space station/Columbus
[AIAA PAPER 87-0931] p 57 A87-33731	the space station p 67 N87-22736	program p 114 N87-20630
Effects of local vibrations on the dynamics of space	High speed simulation of flexible multibody dynamics	Cooperation of the International Space Station partners
truss structures	p 33 N87-22738	in the preparation of the use of space station elements
[AIAA PAPER 87-0941] p 17 A87-33739	Maximum Entropy/Optimal Projection (MEOP) control	for Earth observation (platform and payload aspects)
Wave propagation in periodic truss structures	design synthesis: Optimal quantification of the major design	p 128 N87-20631
[AIAA PAPER 87-0944] p 18 A87-33742	tradeoffs p 9 N87-22741	Report of the atmosphere panel p 161 N87-20633
On sine dwell or broadband methods for modal testing	A new approach for vibration control in large space	Land panel report International Space Station
[AIAA PAPER 87-0961] p 18 A87-33752	structures p 33 N87-22743	p 128 N87-20634
Localization in disordered periodic structures	Modeling of controlled flexible structures with impulsive	Ocean-ice panel report International Space Station
[AIAA PAPER 87-0819] p 19 A87-33757	loads p 33 N87-22745	p 156 N87-20635
Comparison of the Craig-Bampton and residual flexibility	Experimental characterization of deployable trusses and	Solid Earth panel report Columbus program
methods of substructure representation	joints p 33 N87-22749	p 157 N87-20636
p 19 A87-34510	System identification for large space structure damage	Panel report on multidisciplinary instrumentation: New
Application of reanalysis techniques in dynamic analysis	assessment p 33 N87-22750	possibilities Columbus space station
of spacecraft structures p 21 A87-38824	Space station structures and dynamics test program	p 161 N87-20637
	p 33 N87-22751	Data management panel report Columbus polar
Incorporation of the effects of material damping and nonlinearities on the dynamics of space structures	Space station structural dynamics/reaction control	platforms p 114 N87-20639
p 21 A87-40075	system interaction study p 67 N87-22753	The orbit configuration panel report Columbus polar
	An integrated, optimization-based approach to the	platforms p 157 N87-20640
Experiences with the Lanczos method on a parallel	design and control of large space structures [AD-A179459] p 34 N87-23683	Dynamics of an actively controlled flexible Earth
Compater		observation satellite p 71 N87-25356
A formulation for studying dynamics of N connected flexible deployable members p 21 A87-41574	Dynamic and thermal response finite element models of multi-body space structural configurations	EARTH OBSERVING SYSTEM (EOS)
	[NASA-CR-178289] p 10 N87-24709	Earth resources instrumentation for the Space Station
Dynamic analysis and experiment methods for a generic	Some problems in the control of large space	Polar Platform p 126 A87-44184
space station model p 22 A87-41613	structures	Preliminary system concepts for MODIS - A moderate
Interdisciplinary analysis procedures in the modeling and	[AD-A179989] p 70 N87-25350	resolution imaging spectrometer for EOS
control of large space-based structures	Experimental evaluation of small-scale erectable truss	p 126 A87-44186
p 22 A87-42678	hardware	The Earth Observing System (EOS) synthetic aperture
Dynamics of gyroelastic spacecraft p 59 A87-47811	[NASA-TM-89068] p 37 N87-26085	radar (SAR) p 126 A87-44187
Flexibility effects - Estimation of the stiffness matrix in	DYNAMIC TESTS	10000
the dynamics of a large structure p 23 A87-48714	Space station structures and dynamics test program	Problems in merging Earth sensing satellite data sets [NASA-TM-87820] p 129 N87-22457
Dynamic and thermal effects in very large space	[NASA-TP-2710] p 28 N87-20568	
structures p 25 N87-20347	Preliminary design, analysis, and costing of a dynamic	Remote Sensing Information Sciences Research Group:
Studies in nonlinear structural dynamics: Chaotic	scale model of the NASA space station	Santa Barbara Information Sciences Research Group, year
behavior and poynting effect p 26 N87-20348	[NASA-CR-4068] p 36 N87-25606	1 (NASA-CR-181073) p 115 N87-24817
Mechanical Qualification of Large Flexible Spacecraft	DYNAMICAL SYSTEMS	•
Structures	Maximum likelihood identification using an array	EARTH ORBITAL ENVIRONMENTS
[AD-A175529] p 26 N87-20355	processor p 5 A87-32121	Optimal trajectories for aeroassisted, coplanar orbital
Recent developments and future trends in structural	MOVER II - A computer program for verifying	transfer p 54 A87-31681
dynamic design verification and qualification of large	reduced-order models of large dynamic systems	High intensity 5 eV CW laser sustained 0-atom exposure
flexible spacecraft p 156 N87-20357	[SAE PAPER 861790] p 5 A87-32639	facility for material degradation studies
Dynamic analysis of direct television satellite	An identification method for flexible structures	p 105 A87-32060
TV-SAT/TDF.1 p 86 N87-20360	[AIAA PAPER 87-0745] p 16 A87-33669	Selected materials issues associated with Space
Structural qualification of large spacecraft	Evaluation of constraint stabilization procedures for	Station p 105 A87-32061
p 26 N87-20361	multibody dynamical systems	Assessment of space environment induced
Dynamic qualification of spacecraft by means of modal	[AIAA PAPER 87-0927] p 7 A87-33728	microdamage in toughened composite materials
synthesis p 26 N87-20363	Optimal placement of excitations and sensors for	p 20 A87-38609
System Control of the	verification of large dynamical systems	Structure-property relationships in polymer resistance
Modal-survey testing for system identification and	[AIAA PAPER 87-0782] p 19 A87-33755	to atomic oxygen p 106 A87-38642
dynamic qualification of spacecraft structures p 27 N87-20365	Response bounds for linear underdamped systems	Effect of long-term exposure to LEO space environment
	[ASMÉ PAPER 87-APM-34] p 59 A87-42505	on spacecraft materials p 106 A87-39426
Modal testing of the Olympus development model	Air Force basic research in dynamics and control of	Trends in space transportation p 168 A87-41572
stowed solar array p 27 N87-20366	large space structures p 63 N87-20577	The definition of the low earth orbital environment and
Modeling of joints for the dynamic analysis of truss	The coupled dynamics of fluids and spacecraft in low	its effect on thermal control materials
structures	gravity and low gravity fluid measurement	[AIAA PAPER 87-1599] p 43 A87-43103
[NASA-TP-2661] p 28 N87-20567	p 94 N87-21147	Emmerson more reversion of the contract of the

A quasi-analytical method for non-iterative computation

p 66 N87-22731

in space

of nonlinear controls

[NASA-TP-2661]

[NASA-TP-2710]

p 28 N87-20567

Space station structures and dynamics test program NASA-TP-2710] p 28 N87-20568

[NASA-CR-181073]

p 115 N87-24817

[NASA-CP-2484]

The problem of radiation exposure in the Space Station		ELECTRIC CHARGE
[DGLR PAPER 86-175] p 153 A87-48157	Space Station options for constructing advanced solar	Potential modulations on SCATHA (Spacecraft Charging
Effects of space plasma discharge on the performance	[AIAA DADED OF HOOD	At nigh Attitude) spacecraft
or large antenna structures in low Earth orbit	EAST GERMANY p 91 A87-45287	[AD-A176815] p 140 N87-21024
[NASA-1M-89118] p.86 N87-20339		Investigation of beam-plasma interactions
Advanced long term cryogenic storage systems	instrument sector of the GDR contributions	[1.1.01.01.1003/3] p 129 N87-22508
p 94 N87-21142	n 155 A87,53550	Effect of component compression on the initial
Long term cryogenic storage facility systems study	ECONOMIC ANALYSIS	performance of an IPV nickel-hydrogen cell
p 94 N87-21143	The astronaut and the robot - Short- and long-term	Documentation for the SHADO particle wake routine
A preliminary study of extended magnetic field structures in the ionosphere	scenarios for space technology p 101 A87-53991 ECONOMIC FACTORS	
[NASA-CR-181004] p 140 N87-23066	Reconstituting the US space programme	ELECTRIC DISCHARGES p 131 N87-26967
Space station: A program overview	n 168 A87.41210	Effect of component compression on the initial
p 171 N87-24496	EDUCATION	performance of an IPV nickel-hydrogen cell
An evaluation of candidate oxidation resistant materials	Robotic telepresence p 100 A87-46704	[NASA-TM-100102] p 79 N87-24838
for space applications in LEO	Ideas for educational physics experiments in space	Arc propagation, emission and damage on spacecraft
[NASA-TM-100122] p 107 N87-25480	p 130 N87-25033 Workshop on Workload and Training, and Examination	dielectrics p 143 N87-26952
Proceedings of the NASA Workshop on Atomic Oxygen	of their Interactions: Executive summary	Computer modeling of high-voltage solar array experiment using the NASCAP/LEO (NASA Charging
Effects low earth orbital environment [NASA-CR-181163] p.141 N87-26173	[NASA-TM-89459] p 171 N87-25760	Analyzer Program/Low Earth Orbit) computer code
Review of Low Earth Orbital (LEO) flight experiments	EFFICIENCY	[AU-A182589] p 81 N87-28186
p 131 N87-26174	20 kHz Space Station power system	ELECTRIC ENERGY STORAGE
Material interactions with the Low Farth Orbital (LEO)	EIGENVALUES p 76 A87-40378	Development of an alkaline fuel cell subsystem
environment: Accurate reaction rate measurements	A Lanczos eigenvalue method on a parallel computer	[NASA-CH-172002] p 81 N87-28188
p 108 N87-26175	for large complex space structure free vibration	ELECTRIC GENERATORS
Mass spectrometers and atomic oxygen	analysis	The liquid droplet radiator in space: A parametric approach
p 141 N87-26176	[AIAA PAPER 87-0725] p 13 A87-33565	[AD-A182605] p 46 N87-29217
Interaction of hyperthermal atoms on surfaces in orbit: The University of Alabama experiment	Experiences with the Lanczos method on a parallel computer	ELECTRIC MOTORS
p 108 N87-26177	Robust eigensystem assignment for flexible structures	Plasma motor/generator reference system designs for
O-atom degradation mechanisms of materials	[AIAA PAPER 87-2252] n 23 A87-50416	power and propulsion
p 141 N87-26178	A general method for dynamic analysis of structures	[AAS PAPER 86-229] p 89 A87-38572 ELECTRIC POTENTIAL
The role of electronic mechanisms in surface erosion	overview p 31 N87-22707 EIGENVECTORS	Potential modulation on the SCATHA spacecraft
and glow phenomena p 137 N87-26181		n 139 A97 34460
High intensity 5 eV atomic oxygen source and Low Earth	Robust eigensystem assignment for flexible structures [AIAA PAPER 87-2252] p. 23 A87-50416	Potential modulations on SCATHA (Special Charging
Orbit (LEO) simulation facility p 141 N87-26186	ELASTIC BODIES	At high Attitude) spacecraft
Neutral atomic oxygen beam produced by ion charge	Space structure vibration modes - How many exist?	[AD-A176815] p 140 N87-21024
exchange for Low Earth Orbital (LEO) simulation	Which ones are important? n 11 A87-33130	Effect of component compression on the initial performance of an IPV nickel-hydrogen cell
p 131 N87-26188 Pulsed source of energetic atomic oxygen	Instability of an elastic filament in orbit around a gravitating center	[NASA-TM-100102] p 79 N87-24838
p 108 N87-26189	Optimal vibration control by the use of piezoceramic	ELECTRIC POWER
An electrically conductive thermal control surface for	sensors and actuators	The synthesis of the power transmission channel for a
spacecraft encountering Low-Earth Orbit (LEO) atomic	[AIAA PAPER 87-0959] p 18 A87-33751	Satellite solar power station n 75 Ag7-35700
oxygen indium tin oxide-coated thermal blankets	A formulation for studying dynamics of N connected	ELECTRIC POWER SUPPLIES
p 45 N87-26192	flexible deployable members p 21 A87-41574	Power management equipment for space applications [SAE PAPER 861621] p.74 A87-32578
Chemical interactions in Low Earth Orbit (LEO)	Dynamics of gyroelastic spacecraft p 59 A87-47811  ELASTIC DAMPING	An integrated analytic tool and knowledge-based system
p 109 N87-26198 Groundbased studies of spacecraft glow and erosion	New time-domain identification technique for vibrating	approach to aerospace electric power system control
caused by impact of oxygen and nitrogen beams	Structures p.58 A87-40860	[SAE PAPER 8616221 n. 74 Apr 20570
p 109 N87-26200	ELASTIC DEFORMATION	Space Station 20-kHz power management and distribution system
NASA Marshall Space Flight Center atomic oxygen	Analytical solutions for static elastic deformations of wire ropes	Space station electric power system requirements and
investigations p 109 N87-26202	TAIAA DADED OT OTOT	design
An evaluation of candidate oxidation resistant	Model analyses of dynamics of a deformable multipart	[NASA-TM-89889] p 96 N87-22001
materials p 110 N87-26203	spacecraft - The Space Station: A continuum approach	ELECTRIC POWER TRANSMISSION
Martin Marietta atomic oxygen Low Earth Orbit (LEO)	[7177 FAFER 07-0925] n 17 Apr 22727	Space station electrical power distribution analysis using a load flow approach p 80 N87-26699
Comments on the interaction of materials with atomic	A formulation for studying dynamics of N connected	ELECTRIC PROPULSION
Oxygen n 110 Ng7-26206	flexible deployable members p 21 A87-41574 Development of full scale deployable CFRP truss for	Electric propulsion for orbit transfer - A NAVSTAR case
Effect of long-term exposure to Low Earth Orbit (LEO)	space structure p 25 A87-51793	study (Has electric propulsion's time come?)
space environment p 142 N87-26207	Dynamic finite element modeling of flevible structures	[AIAA PAPER 87-0985] D 88 A87-39001
EARTH ORBITAL RENDEZVOUS Rendezvous and docking tracker	[AD-A177 100] n 30 NA7-22252	The use of electric propulsion on low earth orbit spacecraft
[AAS PAPER 86-014] p 133 A87-32733	ELASTIC SHELLS	[AIAA PAPER 87-0989] p 88 A87-38003
EARTH ORBITS	A spline-based parameter and state estimation technique for static models of elastic surfaces	Geosynchronous earth orbit base propulsion - Flectric
Geosynchronous earth orbit base propulsion - Electric	[NASA-CR-180449] p 11 N87-30107	propulsion options
propulsion options [AIAA PAPER 87-0990] D 89 A87-39004	ELASTIC WAVES	[AIAA PAPER 87-0990] p 89 A87-38004
Optimal Shared State of the Control	An experimental study of transient waves in a plane	Development of the electrical power subsystem for the electric propulsion experiment onboard the Space Flyer
[AU-A1/9205] n 120 NR7 22756	grid structure [AIAA PAPER 87-0943] p.18 A87-33741	Unit (SFU)
Optimization of payload mass placement in a dual keep	ELASTODYNAMICS p 18 A87-33741	[AIAA PAPER 87-1040] 0.76 AR7 20628
apace station	Dynamic qualification of spacecraft by means of modal	Development of control and monitor subsystem for
[NASA-TM-89051] p 68 N87-23687 Simulation of on-orbit satellite fragmentations	Synthesis n 26 Me7 20262	electric propulsion experiment onboard Space Flyer Unit
p 140 N87-24515	Modal-survey testing for system identification and	CALAA DADED OF 1911
Computer modeling of high-voltage soler and	dynamic qualification of spacecraft structures	Electrodynamic tether propulsion - Potential uses and
experiment using the NASCAP/I FO (NASA Charging	ELASTOMERS p 27 N87-20365	Open issues n 124 Ap7 40540
Analyzer Program/Low Earth Orbit) computer code	Reactions of atomic oxygen (O(P-3)) with polybutadienes	1987 Status report - United States Air Force clocking
AMOC: An alternative module configuration for	and related polymers p 109 NR7-26107	FALAA DADED OF 10001
advanced solar arrays in low Earth orbits	ELASTOPLASTICITY	[AIAA PAPER 87-1036] p 90 A87-41122 Advanced propulsion activities in the USA
p 159 N87-28968	Substructure analysis using NICE/SPAR and	n 90 A97.41575
LEO and GEO missions p.5 Na7-20016	applications of force to linear and nonlinear structures spacecraft masts	ELECTRIC WIRE p 90 A87-41575
EARTH RESOURCES	[NASA-CR-180317] p 38 N87-27260	Electrodynamic tether propulsion - Potential uses and
Earth resources instrumentation for the Space Station Polar Platform p.126 A87-44184	ELECTRIC ARCS	Open issues n 124 A07 40540
Land panel report International Space Station	Arc propagation, emission and damage on spacecraft	ELECTHICAL FAULTS
p 128 N87-20634	GIGIOCUTICS D 143 NR7-26052	Thermal deformation and electrical degradation of antenna reflector with truss backstructure
EARTH SURFACE	Automatic charge control system for geosynchronous satellites	D 12 AR7 22405
Remote Sensing Information Sciences Research Group:	ELECTRIC BATTERIES	Thick dielectric charging on high altitude spacecraft
Santa Barbara Information Sciences Research Group, year	Space Electrochemical Research and Technology	n 87 N87-26061
[NASA_CD_191079]	(SERT)	ELECTRICAL IMPEDANCE

p 5 N87-29914

Frequency dispersion in the admittance of the polycrystalline Cu2S/CdS solar cell p 5 A87-29133

# **ELECTRICAL INSULATION**

ELECTRICAL INSULATION	ELECTRON TRANSITIONS	Advanced fuel cell concepts for future NASA missions p 99 N87-29930
MARECS and ECS anomalies: Attempt at insulation	The role of electronic mechanisms in surface erosion and glow phenomena p 137 N87-26181	Application of advanced flywheel technology for energy
defect production in Kapton p 82 N87-28980	and glow phenomena p 137 N67-26161  ELECTRONIC CONTROL	storage on space station p 74 N87-29933
ELECTRO-OPTICS The Radarsat Modular Opto-electronic Multispectral	Electronic control/display interface technology	Regenerative fuel cells for space applications p 84 N87-29938
Scanner (R-MOMS): A potential candidate for the Polar	p 88 NB7-29161	ENERGY TECHNOLOGY
Orbiting Platform (POP) also	ELECTROSTATIC CHARGE	Advanced technology for extended endurance alkaline
[MBB-UR-873/86] p 130 N87-25506	Investigation of beam-plasma interactions [NASA-CR-180579] p 129 N87-22508	fuel cells p 75 A87-33787
Space Electrochemical Research and Technology	Electrostatic immunity of geostationary satellites	IKI department head on orbital power plants p 158 N87-27693
(SERT)	p 143 N87-26957	ENERGY TRANSFER
[NASA-CP-2484] p 5 N87-29914	Surface modification to minimise the electrostatic	IKI department head on orbital power plants
Space Electrochemical Research and Technology	charging of Kapton in the space environment p 87 N87-26959	p 158 N87-27693
(SERT)	Automatic charge control system for geosystem coops	ENGINE DESIGN Concepts for space maintenance of OTV engines
[NASA-CP-2484] p 5 N87-29914	satellites p 87 N87-26960	p 137 N87-26097
ELECTRODYNAMICS	Stopping differential charging of solar arrays	ENGINE MONITORING INSTRUMENTS
Electrodynamic plasma motor/generator experiment [AAS PAPER 86-210] p 89 A87-38569	p 83 N87-28984	Development of control and monitor subsystem for electric propulsion experiment onboard Space Flyer Unit
Plasma motor/generator reference system designs for	ELECTROSTATICS	(SFU)
power and propulsion	Electron beam experiments at high altitudes p 142 N87-26946	[AIAA PAPER 87-1041] p 76 A87-39629
[AAS PAPER 86-229] p 89 A87-38572 Electrodynamic tether propulsion - Potential uses and	ELECTROTHERMAL ENGINES	ENGINE TESTING LABORATORIES
open issues p 124 A87-40510	Performance of an SP-100/pulsed electrothermal	Space station propulsion test bed: A complete system
Theory of plasma contactors for electrodynamic tethered	thruster orbit transfer vehicle	ENGINE TESTS
estallita evetams D 85 A87-41609	[AIAA PAPER 87-2027] p // A87-45363 ELEVATORS (LIFTS)	Ion thrusters advance p 93 A87-54196
The radiation impedance of an electrodynamic tether with end connectors p 125 A87-42585	Analytical investigation of the dynamics of tethered	A 25-LBF gaseous oxygen/gaseous hydrogen thruster for space station application p 98 N87-26132
Investigation of plasma contactors for use with orbiting	constellations in Earth orbit, phase 2	for space station application p 98 N87-26132 Proven, long-life hydrogen/oxygen thrust chambers for
wires	[NASA-CR-179149] p 130 N87-26083	space station propulsion p 98 N87-26133
[NASA-CR-180922] p 129 N87-22509	EMBEDDED COMPUTER SYSTEMS A VHSIC general purpose processor	ENGINEERING MANAGEMENT
Thermal and dynamical effects on electrodynamic space	p 116 N87-29145	Preliminary performance characterizations of an engineering model multipropellant resistojet for space
tethers [AD-A180276] p 130 N87-25351	MAX: A space station computer option	station application
Electrodynamic tether p 131 N87-26449	p 116 N87-29146 Testing and analysis of DOD Ada language products	[A]AA PAPER 87-2120] D 93 A87-50197
Investigation of plasma contactors for use with orbiting	for NASA p 172 N87-29155	Preliminary performance characterizations of an
wires [NASA-CR-181422] p 131 N87-29591	FMFRGENCIES	engineering model multipropellant resistojet for space station application
Overen interaction with space-power materials	A systems analysis of emergency escape and recovery	[NASA-TM-100113] p 96 N87-23821
[NASA-CR-181396] p 132 N87-29633	systems for the US space station [AD-A179233] p 3 N87-23680	ENVIRONMENT POLLUTION
ELECTROLUMINESCENCE Head-ported display analysis for Space Station	ENCLOSURES	Resistojet plume and induced environment analysis [NASA-TM-88957] p 96 N87-24536
applications p 111 A87-31463	An evaluation of advanced extravehicular crew	[NASA-TM-88957] p 96 N87-24536 Contamination assessment for OSSA space station IOC
ELECTROLYSIS	enclosures (SAE PAPER 8610091 p 134 A87-38781	payloads
A Space Station utility - Static Feed Electrolyzer	[SAE PAPER 861009] p 134 A87-38781 Space Station EVA using a maneuvering enclosure	[NASA-CR-4091] p 53 N87-26086
[SAE PAPER 860920] p 47 A87-38712 Space Station life support oxygen generation by SPE	unit	ENVIRONMENT SIMULATION  Development of an emulation-simulation thermal control
water electrolyzer systems	[SAE PAPER 861010] p 135 A87-38782	model for space station application
[SAE PAPER 860949] p 49 A87-38736	END EFFECTORS  Development of sensors for remote manipulator system	[NASA-CR-181009] p 45 N87-26072
Electrochemical processing of solid waste	of Japanese Experiment Module p 147 A87-32547	ENVIRONMENTAL CONTROL  Concept study of regenerable carbon dioxide removal
[NASA-CR-181128] p 137 N87-25443 Hydrogen/oxygen economy for the space station	Space Station end effector strategy study	and oxygen recovery system for the Space Station
p 98 N87-26130	[NASA-TM-100488] p 103 N87-29593	p 46 A87-32544
ELECTROMAGNETIC INTERFERENCE	END-TO-END DATA SYSTEMS End-to-end communications for Space Station	Aerospace environmental systems; Proceedings of the
Effects of space plasma discharge on the performance	p 85 A87-45522	Sixteenth Intersociety Conference on Environmental Systems, San Diego, CA, July 14-16, 1986
of large antenna structures in low Earth orbit [NASA-TM-89118] p 86 N87-20339	ENERGETIC PARTICLES	(SAF P-177) p 162 A87-38701
EMC and power quality standards for 20-kHz power	The role of electronic mechanisms in surface erosion and glow phenomena p 137 N87-26181	EDC development and testing for the Space Station
distribution	ENERGY CONSERVATION	program Electrochemical Carbon Dioxide
[NASA-TM-89925] p 78 N87-22004	Air Evaporation closed cycle water recovery technology	Concentration [SAE PAPER 860918] p 118 A87-38710
ELECTROMAGNETIC PROPERTIES  Measurement apparatus and procedure for the	- Advanced energy saving designs (SAF PAPER 860987) p 51 A87-38766	A Space Station utility - Static Feed Electrolyzer
determination of surface emissivities	ENERGY CONSUMPTION	[SAF PAPER 860920] p 47 A87-38712
[NASA-CASE-LAR-13455-1] p 29 N87-21206	Energy expenditure during simulated EVA workloads	Space Station environmental control and life support system distribution and loop closure studies
Documentation for the SHADO particle wake routine	[SAE PAPER 860921] p 163 A87-38713	[SAF PAPER 860942] p 48 A87-38729
[AD-A181531] p 131 N87-26967	ENERGY CONVERSION EFFICIENCY  Advanced photovoltaic solar array design assessment	Status of the Space Station environmental control and
ELECTROMAGNETIC RADIATION  Hoop/column and tetrahedral truss electromagnetic	p 80 N87-26429	life support system design concept [SAF PAPER 860943] p 48 A87-38730
tests p 87 N87-24504	ENERGY DISSIPATION	[SAE PAPER 860943] p 48 A87-38730 Environmental Control Life Support for the Space
ELECTROMAGNETISM	Global treatment of energy dissipation effects for multihody satellites p 62 A87-51610	Station
Controls-structures-electromagnetics interaction	ENERGY DISTRIBUTION	[SAE PAPER 860944] p 48 A87-38731
program p 69 N87-24502	Production of a beam of ground state oxygen atoms	Nuclear powered submarines and the Space Station - A comparison of ECLSS requirements
ELECTROMECHANICAL DEVICES  An electromechanical attenuator/actuator for Space	of selectable energy p 139 A87-38624	{SAE PAPER 860945} p 48 A87-38732
Station docking p 138 N87-29878	System identification for large space structure damage	Integrated air revitalization system for Space Station
FI FOTDOM BEAMS	ENERGY METHODS	[SAE PAPER 860946] p 48 A87-38733
Preliminary results of CHARGE-2 tethered payload	Prediction of random vibrational responses of a large	Evaluation of regenerative portable life support system options
ехреннен	spacecraft in acoustic environment by BLPF method p 144 A87-32334	[SAE PAPER 860948] p 49 A87-38735
ELECTRON BOMBARDMENT On the possibility of a several-kilovolt differential charge	ENERGY STORAGE	Physiological requirements and pressure control of a
in the day sector of a geosynchronous orbit	Intelligent flywheel energy storage units with additional	spaceplane [SAF PAPER 860965] p 150 A87-38747
p 158 N67-20955	functions for future space stations in near-earth orbits	[SAE PAPER 860965] p 150 A87-38747 Columbus Life Support System and its technology
ELECTRON GUNS	[DGLR PAPER 86-172] p 57 A87-36762 A transient analysis of phase change energy storage	development
Investigation of beam-plasma interactions [NASA-CR-180579] p 129 N87-22508	A transient analysis of phase change energy storage system for solar dynamic power	[SAE PAPER 860966] p 150 A87-38748
Electron hearn experiments at high attitudes	(A)AA PAPER 87-1469] p 77 A87-43004	Environmental control and life support technologies for advanced manned space missions
p 142 N87-26946	Application of advanced flywheel technology for energy	[SAE PAPER 860994] p 51 A87-38771
ELECTRON IRRADIATION	storage on space station [DE87-007657] p 68 N87-24028	CELSS waste management systems evaluation
Assessment of space environment induced microdamage in toughened composite materials 7 mecon	Effect of component compression on the initial	[SAE PAPER 860997] p 51 A87-38774
p 20 A87-38009		Control/monitor instrumentation for environmental
	performance of an IPV nickel-hydrogen cell	control and life support evetame aboard the Space
Surface modification to minimise the electrostatic	[NASA-TM-100102] p 79 N87-24838	control and life support systems aboard the Space Station
Surface modification to minimise the electrostatic charging of Kapton in the space environment p 87 N87-26959		control and life support systems aboard the Space

ENVIRONMENTAL MONITORING	ESA software engineering standards for future	EXOBIOLOGY
Vapor fragrancer [NASA-CASE-LAR-13680-1] p 165 N87-25561	programmes	Science and payload options for animal and plant
ENVIRONMENTAL TESTS p 165 N87-25561	[AIAA PAPER 87-2207] p 154 A87-48592	research accommodations aboard the early Space
Proceedings of the NASA Workshop on Atomic Oxygen	Analysis and implementation of automation aspects in	Station
Effects low earth orbital environment	the Columbus and Hermes end to end systems [AIAA PAPER 87-2210] p 154 A87-48595	[SAE PAPER 860953] p 164 A87-38740
[NASA-CR-181163] p 141 N87-26173	The Earth observation activities of the European Space	Space Station gas-grain simulation facility - Application
An evaluation of candidate oxidation resistant	Agency and the use of the polar platform of the	to exobiology p 127 A87-53002
materials p 110 N87-26203	International Space Station p 128 N87-20622	Space biology and medicine on the twenty-fifth
Comments on the interaction of materials with atomic	Possibilities of the further development of Columbus to	anniversary of the first spaceflight of Yuriy Alekseyevich
oxygen p 110 N87-26206	an autonomous European space station	Gagarin p 157 N87-20732
ENVIRONMENTS	[MBB-UR-E-922/86] p 158 N87-25418	Preliminary study of a Biological and Biochemical
SAGA: A project to automate the management of	Space 2000 in Europe p 159 N87-29024 EUROPEAN SPACE PROGRAMS	Analysis Facility (BBAF) for Columbus: Executive summary
software production systems	Francis Control of the Control of th	[ESA-CR(P)-2338] p 158 N87-27698
[NASA-CR-180276] p 10 N87-27412	Europe's future in space p 143 A87-32278 Highlights of the German Space Programme	EXPANDABLE STRUCTURES
EPOXY RESINS	p 143 A87-32282	Deployable geodesic truss structure
Dynamic analysis of the flexible boom in the N-ROSS satellite	Space Station - Overview of the European concept of	[NASA-CASE-LAR-13113-1] p 36 N87-25492
[AD 4404400]	Columbus programme status and content	EXPENDABLE STAGES (SPACECRAFT)
EQUATIONS OF MOTION	p 145 A87-32528	Liquid propulsion technology for expendable and STS
Dynamics of a multibody system with relative translation	Design of a polar platform with an earth observation	launch vehicle transfer stages
on curved, flexible tracks p 58 A87-40867	payload p 122 A87-32538	[AIAA PAPER 87-1934] p 92 A87-45311
Effect of crew motions on the spatial position of a	International cooperation in space	EXPERIMENT DESIGN
spacecraft p 152 A87-41954	p 149 A87-34594	System identification of a truss type space structure
Equations of motion for maneuvering flexible	The European space programme p 150 A87-37962 System aspects of Columbus thermal control	using the multiple boundary condition test (MBCT)
spacecraft p 63 A87-52965	[SAE PAPER 860938] p 150 A87-38727	method [AIAA PAPER 87-0746] p 16 A87-33670
Equations of motion of a space station with emphasis	Europe prepares for manned orbited operations	
on the effects of the gravity gradient	p 151 A87-39594	Optimization of a program of experiments in connection
[NASA-TM-86588] p 64 N87-21993	The Space Station - Uses and users	with the operational planning of studies carried out with a spacecraft p 148 A87-34208
Structural dynamics system model reduction	p 151 A87-40513	a spacecraft p 148 A87-34208 Space Station propulsion system test bed and control
p 32 N87-22727	Thoughts on Europe's future in space	system testing results
Notes on implementation of Coulomb friction in coupled dynamical simulations p 67 N87-22746	p 151 A87-41219	[AIAA PAPER 87-1858] p 91 A87-45255
Optimal shuttle altitude changes using tethers	Status and tendencies for low to medium thrust	Cryogenic Fluid Management Flight Experiment
[AD-A179205] p 129 N87-22756	propulsion systems [IAF PAPER 86-162] p.90 AR7-42680	(CFMFE) p 95 N87-21150
EQUIPMENT SPECIFICATIONS	The Columbus system baseline and interfaces	Shuttle middeck fluid transfer experiment: Lessons
A space debris simulation facility for spacecraft materials	p 156 A87-53923	learned p 95 N87-21158
evaluation p 11 A87-32058	Cooperation between Europe and the United States in	Study on investigation of the attitude control of large
Vibration isolation for line of sight performance	space (The Fulbright 40th Anniversary Lecture)	flexible spacecraft. Phase 2, volume 1: Executive summary
improvement p 67 N87-22742 EROSION	p 170 A87-53924	laboratory test model
	The Earth observation activities of the European Space	[ESA-CR(P)-2361-VOL-1] p 73 N87-27707
The role of electronic mechanisms in surface erosion and glow phenomena p 137 N87-26181	Agency and the use of the polar platform of the	Study on the investigation of the attitude control of large
and glow phenomena p 137 N87-26181 Effect of long-term exposure to Low Earth Orbit (LEO)	International Space Station p 128 N87-20622 The Columbus program: An overview	flexible spacecraft. Phase 2, volume 2: Technical report
Space environment p 142 N87-26207	. •	laboratory test model [ESA-CR(P)-2361-VOL-2] p 73 N87-27708
Effects on advanced materials: Results of the STS-8	p 156 N87-20623 European utilization aspects studies space stations	
EOIM (Effects of Oxygen Interaction with Materials)		Optimizing experimental programs in operational
EOIM (Effects of Oxygen Interaction with Materials) experiment	p 156 N87-20624	planning of research carried out from spacecraft
experiment [AD-A182931] p 110 N87-29709	p 156 N87-20624 ESA Columbus polar platform design concept p 156 N87-20627	planning of research carried out from spacecraft p 160 N87-29553
experiment [AD-A182931] p 110 N87-29709 ESA SPACECRAFT	p 156 N87-20624 ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform Columbus space	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT  Modal-survey testing of the Olympus spacecraft	p 156 N87-20624 ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform Columbus space station p 136 N87-20628	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS Expert systems in space p 111 A87-32075
experiment [AD-A182931] p 110 N87-29709 ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266	p 156 N87-20624 ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform Columbus space station p 136 N87-20628 USA-Europe coordination and cooperation activities:	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS Expert systems in space p 111 A87-32075 An integrated analytic tool and knowledge-based system
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft  p 152 A87-42266  ESCAPE SYSTEMS	p 156 N87-20624 ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform Columbus space station USA-Europe coordination and cooperation activities: Announcements of Opportunity polar platforms	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery	p 156 N87-20624  ESA Columbus polar platform design concept p 156 N87-20627  Servicing of the polar platform Columbus space station USA-Europe coordination and cooperation activities: Announcements of Opportunity polar platforms p 170 N87-20632	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075 An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579 User interface design quidelines for expert
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform Columbus space station p 136 N87-20628 USA-Europe coordination and cooperation activities: Announcements of Opportunity polar platforms p 170 N87-20632 The Columbus program p 157 N87-26331	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS Expert systems in space p 111 A87-32075 An integrated analytic tool and knowledge-based system approach to aerospace electric power system control
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES	p 156 N87-20624  ESA Columbus polar platform design concept	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems for Space Station p 6 A87-33050
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter	p 156 N87-20624  ESA Columbus polar platform design concept	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems for Space Station  Complex system monitoring and fault diagnosis using
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform Columbus space station USA-Europe coordination and cooperation activities: Announcements of Opportunity polar platforms p 170 N87-20628 The Columbus program p 157 N87-25031 Study of expert system applications to space projects [NE-51-867] Control engineering tasks in the framework of the Columbus program	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems for Space Station p 6 A87-33050  Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform Columbus space station p 136 N87-20628 USA-Europe coordination and cooperation activities: Announcements of Opportunity polar platforms p 170 N87-20632 The Columbus program p 157 N87-20632 Study of expert system applications to space projects [NE-51-867] p 115 N87-26057 Control engineering tasks in the framework of the Columbus program [MBB-UR-E-912/86] p 158 N87-26842	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems for Space Station  Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363  Mission scheduling expert system and its space station
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems for Space Station p 6 A87-33050  Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363  Mission scheduling expert system and its space station applications
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] User interface design guidelines for expert troubleshooting systems for Space Station p 6 A87-33050  Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363  Mission scheduling expert system and its space station applications  [AIAA PAPER 87-2221]
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems for Space Station  Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363  Mission scheduling expert system and its space station applications  [AIAA PAPER 87-2221] p 7 A87-48602  The Oak Ridge National Laboratory's Robotics and Intelligent Systems Program
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A18302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197  EULER EQUATIONS OF MOTION	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems for Space Station p 6 A87-33050  Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363  Mission scheduling expert system and its space station applications  [AIAA PAPER 87-2221] p 7 A87-48602  The Oak Ridge National Laboratory's Robotics and Intelligent Systems Program  [DE87-004627] p 101 N87-20774
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197  EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rioid	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems for Space Station p 6 A87-3050  Complex system monitoring and fault diagnosis using communicating expert system and its space station applications  [AIAA PAPER 87-2221] p 7 A87-48602  The Oak Ridge National Laboratory's Robotics and Intelligent Systems Program  [DE87-004627] p 101 N87-20774  Study of expert system applications to space projects
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers  EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rigid spacecraft	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems for Space Station  Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363  Mission scheduling expert system and its space station applications  [AIAA PAPER 87-2221] p 7 A87-48602  The Oak Ridge National Laboratory's Robotics and intelligent Systems Program  [DE87-004627] p 101 N87-20774  Study of expert system applications to space projects (NE-51-867)
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197  EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rigid spacecraft [NASA-CR-181130] p 72 N87-26038	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems for Space Station p 6 A87-33050  Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363  Mission scheduling expert system and its space station applications  [AIAA PAPER 87-2221] p 7 A87-48602  The Oak Ridge National Laboratory's Robotics and Intelligent Systems Program  [DE87-004627] p 101 N87-20774  Study of expert system applications to space projects [NE-51-867]  Proceedings: Computer Science and Data Systems
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197  EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rigid spacecraft [NASA-CR-181130] p 72 N87-26038  EURECA (ESA)	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems for Space Station p 6 A87-3050  Complex system monitoring and fault diagnosis using communicating expert system p 119 A87-40363  Mission scheduling expert system and its space station applications  [AIAA PAPER 87-2221] p 7 A87-48602  The Oak Ridge National Laboratory's Robotics and Intelligent Systems Program  [DE87-004627] p 101 N87-20774  Study of expert system applications to space projects [NE-51-867] p 115 N87-26057  Proceedings: Computer Science and Data Systems Technical Symposium, volume 1
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rigid spacecraft [NASA-CR-181130] p 72 N87-26038  EURECA (ESA) Eureca - A first step towards the Space Station	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems for Space Station  Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363  Mission scheduling expert system and its space station applications  [AIAA PAPER 87-2221] p 7 A87-48602  The Oak Ridge National Laboratory's Robotics and intelligent Systems Program  [DE87-004627] p 101 N87-20774  Study of expert system applications to space projects [NE-51-867] p 115 N87-26057  Proceedings: Computer Science and Data Systems  Technical Symposium, volume 1  [NASA-TM-89285] p 116 N87-29124
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197  EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rigid spacecraft [NASA-CR-181130] p 72 N87-26038  EURECA (ESA) Eureca - A first step towards the Space Station	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems for Space Station p 6 A87-33050  Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363  Mission scheduling expert system and its space station applications  [AIAA PAPER 87-2221] p 7 A87-48602  The Oak Ridge National Laboratory's Robotics and Intelligent Systems Program  [DE87-004627] p 101 N87-20774  Study of expert system applications to space projects (NE-51-867) p 115 N87-26057  Proceedings: Computer Science and Data Systems Technical Symposium, volume 1  [NASA-TM-89285] p 116 N87-29124  Proceedings: Computer Science and Data Systems
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197  EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rigid spacecraft [NASA-CR-181130] p 72 N87-26038  EURECA (ESA) Eureca - A first step towards the Space Station p 146 A87-32537  Status of the RITA - Experiment on EURECA Radio Frequency Ion Thrustor Assembly	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems for Space Station p 6 A87-33050  Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363  Mission scheduling expert system and its space station applications  [AIAA PAPER 87-2221] p 7 A87-48602  The Oak Ridge National Laboratory's Robotics and Intelligent Systems Program  [DE87-004627] p 101 N87-2077  Study of expert system applications to space projects [NE-51-867] p 115 N87-26057  Proceedings: Computer Science and Data Systems Technical Symposium, volume 1  [NASA-TM-89285] p 116 N87-29124  Proceedings: Computer Science and Data Systems Technical Symposium, volume 2  [NASA-TM-89286] p 116 N87-29144
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197  EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rigid spacecraft [NASA-CR-181130] p 72 N87-26038  EURECA (ESA) Eureca - A first step towards the Space Station p 146 A87-32537 Status of the RITA - Experiment on EURECA Radio Frequency Ion Thrustor Assembly [AIAA PAPER 87-0988]	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems — for Space Station p 6 A87-33050  Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363  Mission scheduling expert system and its space station applications  [AIAA PAPER 87-2221] p 7 A87-48602  The Oak Ridge National Laboratory's Robotics and Intelligent Systems Program  [DE87-004627] p 101 N87-20774  Study of expert system applications to space projects (NE-51-867) p 115 N87-26057  Proceedings: Computer Science and Data Systems Technical Symposium, volume 1  [NASA-TM-89286] p 116 N87-29124  EXPOSURE
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197  EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rigid spacecraft [NASA-CR-181130] p 72 N87-26038  EURECA (ESA) Eureca - A first step towards the Space Station p 146 A87-32537  Status of the RITA - Experiment on EURECA Radio Frequency Ion Thrustor Assembly [AIAA PAPER 87-0988] p 123 A87-38002 The capabilities of Eureca thermal control for future	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems for Space Station p 6 A87-33050  Complex system monitoring and fault diagnosis using communicating expert system and its space station applications  [AIAA PAPER 87-2221] p 7 A87-48602  The Oak Ridge National Laboratory's Robotics and Intelligent Systems Program  [DE87-004627] p 101 N87-20774  Study of expert system applications to space projects [NE-51-867] p 115 N87-26057  Proceedings: Computer Science and Data Systems Technical Symposium, volume 1  [NASA-TM-89285] p 116 N87-29124  EXPOSURE  Review of Low Earth Orbital (LEO) flight experiments
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197  EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rigid spacecraft [NASA-CR-181130] p 72 N87-26038  EURECA (ESA)  Eureca - A first step towards the Space Station p 146 A87-32537  Status of the RITA - Experiment on EURECA Radio Frequency Ion Thrustor Assembly [AIAA PAPER 87-0988] p 123 A87-38002 The capabilities of Eureca thermal control for future mission scenarios	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems for Space Station p 6 A87-33050  Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363  Mission scheduling expert system and its space station applications  [AIAA PAPER 87-2221] p 7 A87-48602  The Oak Ridge National Laboratory's Robotics and Intelligent Systems Program  [DE87-004627] p 101 N87-2077  Study of expert system applications to space projects [NE-51-867] p 115 N87-26057  Proceedings: Computer Science and Data Systems Technical Symposium, volume 1  [NASA-TM-89285] p 116 N87-29124  Proceedings: Computer Science and Data Systems Technical Symposium, volume 2  [NASA-TM-89286] p 116 N87-29144  EXPOSURE  Review of Low Earth Orbital (LEO) flight experiments
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes p 109 N87-26197  EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rigid spacecraft [NASA-CR-181130] p 72 N87-26038  EURECA (ESA) Eureca - A first step towards the Space Station p 146 A87-32537  Status of the RITA - Experiment on EURECA Radio Frequency fon Thrustor Assembly [AIAA PAPER 87-0998] p 123 A87-38002 The capabilities of Eureca thermal control for future mission scenarios [SAE PAPER 860936] p 42 A87-38725	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems for Space Station  Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363  Mission scheduling expert system and its space station applications  [AIAA PAPER 87-2221] p 7 A87-48602  The Oak Ridge National Laboratory's Robotics and intelligent Systems Program  [DE87-004627] p 115 N87-20774  Study of expert system applications to space projects (NE-51-867) p 115 N87-26057  Proceedings: Computer Science and Data Systems Technical Symposium, volume 1  [NASA-TM-89285] p 116 N87-29124  Proceedings: Computer Science and Data Systems Technical Symposium, volume 2  [NASA-TM-89286] p 116 N87-29144  EXPOSURE  Review of Low Earth Orbital (LEO) flight experiments p 131 N87-26174  Material interactions with the Low Earth Orbital (LEO)
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197  EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rigid spacecraft [NASA-CR-181130] p 72 N87-26038  EURECA (ESA) Eureca - A first step towards the Space Station p 146 A87-32537  Status of the RITA - Experiment on EURECA Radio Frequency Ion Thrustor Assembly [AIAA PAPER 87-0988] p 123 A87-38002 The capabilities of Eureca thermal control for future mission scenarios [SAE PAPER 860936] p 42 A87-38725 Microgravity experiments onboard Eureca	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems for Space Station p 6 A87-33050  Complex system monitoring and fault diagnosis using communicating expert system and its space station applications  [AIAA PAPER 87-2221] p 7 A87-48602  The Oak Ridge National Laboratory's Robotics and Intelligent Systems Program  [DE87-004627] p 101 N87-20774  Study of expert system applications to space projects [NE-51-867] p 115 N87-26057  Proceedings: Computer Science and Data Systems Technical Symposium, volume 1  [NASA-TM-89285] p 116 N87-29124  Proceedings: Computer Science and Data Systems Technical Symposium, volume 2  [NASA-TM-89286] p 116 N87-29144  EXPOSURE  Review of Low Earth Orbital (LEO) flight experiments p 131 N87-26174  Material interactions with the Low Earth Orbital (LEO) environment: Accurate reaction rate measurements
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197  EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rigid spacecraft [NASA-CR-181130] p 72 N87-26038  EURECA (ESA)  Eureca - A first step towards the Space Station p 146 A87-32537  Status of the RITA - Experiment on EURECA Radio Frequency Ion Thrustor Assembly [AIAA PAPER 87-0988] p 123 A87-38002 The capabilities of Eureca thermal control for future mission scenarios [SAE PAPER 860936] p 42 A87-38725 Microgravity experiments onboard Eureca p 155 A87-53554	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems for Space Station p 6 A87-33050  Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363  Mission scheduling expert system and its space station applications  [AIAA PAPER 87-2221] p 7 A87-48602  The Oak Ridge National Laboratory's Robotics and Intelligent Systems Program  [DE87-004627] p 101 N87-20774  Study of expert system applications to space projects [NE-51-867] p 115 N87-26057  Proceedings: Computer Science and Data Systems Technical Symposium, volume 1  [NASA-TM-89285] p 116 N87-29124  Proceedings: Computer Science and Data Systems Technical Symposium, volume 2  [NASA-TM-89286] p 116 N87-29144  EXPOSURE  Review of Low Earth Orbital (LEO) flight experiments p 131 N87-26174  Material interactions with the Low Earth Orbital (LEO) environment: Accurate reaction rate measurements
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes p 109 N87-26197  EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rigid spacecraft [NASA-CR-181130] p 72 N87-26038  EURECA (ESA) Eureca - A first step towards the Space Station p 146 A87-32537  Status of the RITA - Experiment on EURECA Radio Frequency Ion Thrustor Assembly [AIAA PAPER 87-0988] p 123 A87-38002 The capabilities of Eureca thermal control for future mission scenarios [SAE PAPER 860936] p 42 A87-38725 Microgravity experiments onboard Eureca p 155 A87-53554 From Eureca-A to Eureca-B	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems for Space Station  Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363  Mission scheduling expert system and its space station applications  [AIAA PAPER 87-2221] p 7 A87-48602  The Oak Ridge National Laboratory's Robotics and intelligent Systems Program  [DE87-004627] p 101 N87-20774  Study of expert system applications to space projects (NE-51-867] p 115 N87-26057  Proceedings: Computer Science and Data Systems Technical Symposium, volume 1  [NASA-TM-89285] p 116 N87-29124  Proceedings: Computer Science and Data Systems Technical Symposium, volume 2  [NASA-TM-89286] p 116 N87-29144  EXPOSURE  Review of Low Earth Orbital (LEO) flight experiments p 131 N87-26174  Material interactions with the Low Earth Orbital (LEO) environment: Accurate reaction rate measurements p 108 N87-26175 Interaction of hyperthermal atoms on surfaces in orbiti-
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197  EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rigid spacecraft [NASA-CR-181130] p 72 N87-26038  EURECA (ESA)  Eureca - A first step towards the Space Station p 146 A87-32537  Status of the RITA - Experiment on EURECA Radio Frequency Ion Thrustor Assembly [AIAA PAPER 87-0988] p 123 A87-38002 The capabilities of Eureca thermal control for future mission scenarios [SAE PAPER 860936] p 42 A87-38725  Microgravity experiments onboard Eureca p 155 A87-53554 From Eureca-A to Eureca-B Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems — for Space Station p 6 A87-33050  Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363  Mission scheduling expert system and its space station applications  [AIAA PAPER 87-2221] p 7 A87-48602  The Oak Ridge National Laboratory's Robotics and intelligent Systems Program  [DE87-004627] p 101 N87-20774  Study of expert system applications to space projects [NE-51-867] p 115 N87-26057  Proceedings: Computer Science and Data Systems Technical Symposium, volume 1  [NASA-TM-89285] p 116 N87-29124  Proceedings: Computer Science and Data Systems Technical Symposium, volume 2  [NASA-TM-89286] p 116 N87-29144  EXPOSURE  Review of Low Earth Orbital (LEO) flight experiments p 131 N87-26174  Material interactions with the Low Earth Orbital (LEO) environment: Accurate reaction rate measurements  p 108 N87-26177  Interaction of hyperthermal atoms on surfaces in orbit: The University of Alabama experiment
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes p 109 N87-26197  EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rigid spacecraft [NASA-CR-181130] p 72 N87-26038  EURECA (ESA) Eureca - A first step towards the Space Station p 146 A87-32537  Status of the RITA - Experiment on EURECA Radio Frequency Ion Thrustor Assembly [AIAA PAPER 87-0998] p 123 A87-38002 The capabilities of Eureca thermal control for future mission scenarios [SAE PAPER 860936] p 42 A87-38725 Microgravity experiments onboard Eureca p 155 A87-53554 From Eureca-A to Eureca-B p 155 A87-53516 Botanical payloads for platforms and space stations [MBB-UR-E-921/86] The evolution of a serviceable EURECA	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems for Space Station p 6 A87-33050  Complex system monitoring and fault diagnosis using communicating expert system and its space station applications  [AIAA PAPER 87-2221] p 7 A87-48602  The Oak Ridge National Laboratory's Robotics and Intelligent Systems Program  [DE87-004627] p 101 N87-20774  Study of expert system applications to space projects [NE-51-867] p 115 N87-26057  Proceedings: Computer Science and Data Systems Technical Symposium, volume 1  [NASA-TM-89285] p 116 N87-29124  Proceedings: Computer Science and Data Systems Technical Symposium, volume 2  [NASA-TM-89286] p 116 N87-29144  EXPOSURE  Review of Low Earth Orbital (LEO) flight experiments p 131 N87-26174  Material interactions with the Low Earth Orbital (LEO) environment: Accurate reaction rate measurements p 108 N87-26175  Interaction of hyperthermal atoms on surfaces in orbit: The University of Alabama experiment
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197  EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rigid spacecraft [NASA-CR-181130] p 72 N87-26038  EURECA (ESA) Eureca - A first step towards the Space Station p 146 A87-32537  Status of the RITA - Experiment on EURECA Radio Frequency Ion Thrustor Assembly [AIAA PAPER 87-0988] p 123 A87-38002 The capabilities of Eureca thermal control for future mission scenarios [SAE PAPER 860936] p 42 A87-38725 Microgravity experiments onboard Eureca p 155 A87-53916 Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340 The evolution of a serviceable EURECA [MBB-UR-E-921/86] p 121 N87-26841	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	Planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems for Space Station p 6 A87-33050  Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363  Mission scheduling expert system and its space station applications  [AIAA PAPER 87-2221] p 7 A87-48602  The Oak Ridge National Laboratory's Robotics and Intelligent Systems Program  [DE87-004627] p 101 N87-20774  Study of expert system applications to space projects (NE-51-867) p 115 N87-26057  Proceedings: Computer Science and Data Systems Technical Symposium, volume 1  [NASA-TM-89285] p 116 N87-29124  Proceedings: Computer Science and Data Systems Technical Symposium, volume 2  [NASA-TM-89286] p 116 N87-29144  EXPOSURE  Review of Low Earth Orbital (LEO) flight experiments p 131 N87-26176  Material interactions with the Low Earth Orbital (LEO) environment: Accurate reaction rate measurements p 108 N87-26175  Interaction of hyperthermal atoms on surfaces in orbit: The University of Alabama experiment     p 108 N87-26177  O-atom degradation mechanisms of materials p 141 N87-26178
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197  EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rigid spacecraft [NASA-CR-181130] p 72 N87-26038  EURECA (ESA) Eureca - A first step towards the Space Station p 146 A87-32537  Status of the RITA - Experiment on EURECA Radio Frequency Ion Thrustor Assembly [AIAA PAPER 87-0988] p 123 A87-38002 The capabilities of Eureca thermal control for future mission scenarios [SAE PAPER 860936] p 42 A87-38725 Microgravity experiments onboard Eureca p 155 A87-53554 From Eureca-A to Eureca-B p 155 A87-53916 Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 151 N87-26841 EURECA application of the Retractable Advanced Rigid	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	Planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075 An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579 User interface design guidelines for expert troubleshooting systems — for Space Station p 6 A87-33050 Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363 Mission scheduling expert system and its space station applications [AIAA PAPER 87-2221] p 7 A87-48602 The Oak Ridge National Laboratory's Robotics and intelligent Systems Program [DE87-004827] p 101 N87-20774 Study of expert system applications to space projects [NE-51-867] p 115 N87-26057 Proceedings: Computer Science and Data Systems Technical Symposium, volume 1 [NASA-TM-89285] p 116 N87-29124 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144 EXPOSURE Review of Low Earth Orbital (LEO) flight experiments p 131 N87-26174 Material interactions with the Low Earth Orbital (LEO) environment: Accurate reaction rate measurements p 108 N87-26175 Interaction of hyperthermal atoms on surfaces in orbit: The University of Alabama experiment P 108 N87-26177 O-atom degradation mechanisms of materials
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes p 109 N87-26197  EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rigid spacecraft [NASA-CR-181130] p 72 N87-26038  EURECA (ESA) Eureca - A first step towards the Space Station p 146 A87-32537  Status of the RITA - Experiment on EURECA Radio Frequency Ion Thrustor Assembly [AIAA PAPER 87-0998] p 123 A87-38002 The capabilities of Eureca thermal control for future mission scenarios [SAE PAPER 860936] p 42 A87-38725 Microgravity experiments onboard Eureca p 155 A87-53554 From Eureca-A to Eureca-B p 155 A87-53916 Botanical payloads for platforms and space stations p 158 N87-25340 The evolution of a serviceable EURECA [MBB-UR-E-921/86] EURECA application of the Retractable Advanced Rigid Array (RARA) solar array p 82 N87-2873	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	Planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075 An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579 User interface design guidelines for expert troubleshooting systems p 19 PA87-40363 Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363 Mission scheduling expert system and its space station applications [AIAA PAPER 87-2221] p 7 A87-48602 The Oak Ridge National Laboratory's Robotics and intelligent Systems Program [DE87-004827] p 101 N87-20774 Study of expert system applications to space projects [NE-51-867] p 115 N87-26057 Proceedings: Computer Science and Data Systems Technical Symposium, volume 1 [NASA-TM-89285] p 116 N87-29124 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144 EXPOSURE Review of Low Earth Orbital (LEO) flight experiments p 131 N87-26174 Material interactions with the Low Earth Orbital (LEO) environment: Accurate reaction rate measurements p 108 N87-26175 Interaction of hyperthermal atoms on surfaces in orbit: The University of Alabama experiment P 108 N87-26177 O-atom degradation mechanisms of materials P 141 N87-26178  EXTENSIONS Evaluation of carbon-carbon for space engine nozzle
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes p 109 N87-26197  EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rigid spacecraft [NASA-CR-181130] p 72 N87-26038  EURECA (ESA) Eureca - A first step towards the Space Station p 146 A87-32537  Status of the RITA - Experiment on EURECA Radio Frequency Ion Thrustor Assembly [AIAA PAPER 87-0988] p 123 A87-38002 The capabilities of Eureca thermal control for future mission scenarios [SAE PAPER 860936] p 42 A87-38725  Microgravity experiments onboard Eureca p 155 A87-53540 Microgravity experiments onboard Eureca p 155 A87-535916 Botanical psyloads for platforms and space stations p 158 N87-25340 The evolution of a serviceable EURECA [MBB-UR-E-923/86] p 121 N87-26841 EURECA application of the Retractable Advanced Rigid Array (RARA) solar array p 82 N87-28973 Improved solar generator technology for the EURECA	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	Planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems for Space Station p 6 A87-33050  Complex system monitoring and fault diagnosis using communicating expert system and its space station applications  [AIAA PAPER 87-2221] p 7 A87-48602  The Oak Ridge National Laboratory's Robotics and Intelligent Systems Program  [DE87-004627] p 101 N87-20774  Study of expert system applications to space projects [NE-51-867] p 115 N87-26057  Proceedings: Computer Science and Data Systems Technical Symposium, volume 1  [NASA-TM-89285] p 116 N87-29124  Proceedings: Computer Science and Data Systems Technical Symposium, volume 2  [NASA-TM-89286] p 116 N87-29144  EXPOSURE  Review of Low Earth Orbital (LEO) flight experiments p 131 N87-26178  EXPOSURE  Review of Alabama experiment  P 108 N87-26175  Interaction of hyperthermal atoms on surfaces in orbit: The University of Alabama experiment  P 108 N87-26177  O-atom degradation mechanisms of materials  EXTENSIONS  EVALUATION EXPERTMENT STATES AND TRANS TO THE P 10 N87-26116
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197  EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rigid spacecraft [NASA-CR-181130] p 72 N87-26038  EURECA (ESA) Eureca - A first step towards the Space Station p 146 A87-32537  Status of the RITA - Experiment on EURECA Radio Frequency fon Thrustor Assembly [AIAA PAPER 87-0988] p 123 A87-38002 The capabilities of Eureca thermal control for future mission scenarios [SAE PAPER 860936] p 42 A87-38725 Microgravity experiments onboard Eureca p 155 A87-53554 From Eureca-A to Eureca-B p 155 A87-53916 Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340 The evolution of a serviceable EURECA [MBB-UR-E-923/86] p 158 N87-25841 EURECA application of the Retractable Advanced Rigid Array (RARA) solar array   p 82 N87-28973   Improved solar generator technology for the EURECA   DW Earth orbit   p 159 N87-28974	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	Planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075 An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579 User interface design guidelines for expert troubleshooting systems p 19 PA87-40363 Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363 Mission scheduling expert system and its space station applications [AIAA PAPER 87-2221] p 7 A87-48602 The Oak Ridge National Laboratory's Robotics and intelligent Systems Program [DE87-004827] p 101 N87-20774 Study of expert system applications to space projects [NE-51-867] p 115 N87-26057 Proceedings: Computer Science and Data Systems Technical Symposium, volume 1 [NASA-TM-89285] p 116 N87-29124 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144 EXPOSURE Review of Low Earth Orbital (LEO) flight experiments p 131 N87-26174 Material interactions with the Low Earth Orbital (LEO) environment: Accurate reaction rate measurements p 108 N87-26175 Interaction of hyperthermal atoms on surfaces in orbit: The University of Alabama experiment P 108 N87-26177 O-atom degradation mechanisms of materials p 141 N87-26178 EXTENSIONS Evaluation of carbon-carbon for space engine nozzle p 98 N87-26116
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197  EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rigid spacecraft [NASA-CR-181130] p 72 N87-26038  EURECA (ESA) Eureca - A first step towards the Space Station p 146 A87-32537  Status of the RITA - Experiment on EURECA Radio Frequency fon Thrustor Assembly [AIAA PAPER 87-0998] p 123 A87-38002 The capabilities of Eureca thermal control for future mission scenarios [SAE PAPER 860936] p 42 A87-38725 Microgravity experiments onboard Eureca p 155 A87-53916 Botanical payloads for platforms and space stations p 158 N87-25340 The evolution of a serviceable EURECA [MBB-UR-E-921/86] p 121 N87-26841 EURECA application of the Retractable Advanced Rigid Array (RARA) solar array p 82 N87-28973 Improved solar generator technology for the EURECA low Earth orbit Advanced Solar GaAs Array (ASGA) experiment on	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075 An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579 User interface design guidelines for expert troubleshooting systems p 19 PA87-40363 Complex systems p 6 A87-33050 Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363 Mission scheduling expert system and its space station applications [AIAA PAPER 87-2221] p 7 A87-48602 The Oak Ridge National Laboratory's Robotics and intelligent Systems Program [DE87-004827] p 101 N87-20774 Study of expert system applications to space projects [NE-51-867] p 115 N87-26057 Proceedings: Computer Science and Data Systems Technical Symposium, volume 1 [NASA-TM-89285] p 116 N87-29124 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144 EXPOSURE Review of Low Earth Orbital (LEO) flight experiments p 131 N87-26174 Material interactions with the Low Earth Orbital (LEO) environment: Accurate reaction rate measurements p 108 N87-26175 Interaction of hyperthermal atoms on surfaces in orbit: The University of Alabama experiment p 108 N87-26177 O-atom degradation mechanisms of materials p 141 N87-26178  EXTENSIONS Evaluation of carbon-carbon for space engine nozzle p 98 N87-26116
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes p 109 N87-26197  EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rigid spacecraft [NASA-CR-181130] p 72 N87-26038  EURECA (ESA) Eureca - A first step towards the Space Station p 146 A87-32537  Status of the RITA - Experiment on EURECA Radio Frequency Ion Thrustor Assembly [AIAA PAPER 87-0998] p 123 A87-38002 The capabilities of Eureca thermal control for future mission scenarios [SAE PAPER 860936] p 42 A87-38725 Microgravity experiments onboard Eureca p 155 A87-53514 Botanical payloads for platforms and space stations p 158 N87-25340 The evolution of a serviceable EURECA [MBB-UR-E-921/86] p 151 N87-26841 EURECA application of the Retractable Advanced Rigid Array (RARA) solar array p 82 N87-28973 Improved solar GaAs Array (ASGA) experiment on EURECA: Flight objectives and instrument configuration	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems — for Space Station p 6 A87-33050  Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363  Mission scheduling expert system and its space station applications  [AIAA PAPER 87-2221] p 7 A87-48602  The Oak Ridge National Laboratory's Robotics and Intelligent Systems Program  [DE87-004827] p 101 N87-20774  Study of expert system applications to space projects [NE-51-867] p 115 N87-26057  Proceedings: Computer Science and Data Systems Technical Symposium, volume 1  [NASA-TM-89285] p 116 N87-29124  Proceedings: Computer Science and Data Systems Technical Symposium, volume 2  [NASA-TM-89286] p 116 N87-29144  EXPOSURE  Review of Low Earth Orbital (LEO) flight experiments p 131 N87-26174  Material interactions with the Low Earth Orbital (LEO) environment: Accurate reaction rate measurements p 108 N87-26175  Interaction of hyperthermal atoms on surfaces in orbit: The University of Alabama experiment  P 108 N87-26177  O-atom degradation mechanisms of materials p 141 N87-26178  EXTENSIONS  Evaluation of carbon-carbon for space engine nozzle p 98 N87-26116  EXTRASOLAR PLANETS  Astrometric telescope of ten microarcsecond accuracy on the Space Station  P 122 A87-35222  Astronomic Telescope Facility: Pralimingry systems
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197  EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rigid spacecraft [NASA-CR-181130] p 72 N87-26038  EURECA (ESA) Eureca - A first step towards the Space Station p 146 A87-32537  Status of the RITA - Experiment on EURECA Radio Frequency fon Thrustor Assembly [AIAA PAPER 87-0998] p 123 A87-38002 The capabilities of Eureca thermal control for future mission scenarios [SAE PAPER 860936] p 42 A87-38725 Microgravity experiments onboard Eureca p 155 A87-53916 Botanical payloads for platforms and space stations p 158 N87-25340 The evolution of a serviceable EURECA [MBB-UR-E-921/86] p 121 N87-26841 EURECA application of the Retractable Advanced Rigid Array (RARA) solar array p 82 N87-28973 Improved solar generator technology for the EURECA low Earth orbit Advanced Solar GaAs Array (ASGA) experiment on	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075 An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579 User interface design guidelines for expert troubleshooting systems — for Space Station p 6 A87-33050 Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363 Mission scheduling expert system and its space station applications [AIAA PAPER 87-2221] p 7 A87-48602 The Oak Ridge National Laboratory's Robotics and intelligent Systems Program [DE87-004627] p 101 N87-20774 Study of expert system applications to space projects [NE-51-867] p 115 N87-26057 Proceedings: Computer Science and Data Systems Technical Symposium, volume 1 [NASA-TM-89285] p 116 N87-29124 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144 EXPOSURE Review of Low Earth Orbital (LEO) flight experiments p 131 N87-26174 Material interactions with the Low Earth Orbital (LEO) environment: Accurate reaction rate measurements p 108 N87-26175 Interaction of hyperthermal atoms on surfaces in orbit: The University of Alabama experiment  P 108 N87-26176  EXTENSIONS Evaluation of carbon-carbon for space engine nozzle p 98 N87-26116  EXTRASOLAR PLANETS Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222 Astronomic Telescope Facility: Preliminary systems definition study report. Volume 2: Technical description
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197  EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rigid spacecraft [NASA-CR-181130] p 72 N87-26038  EURECA (ESA) Eureca - A first step towards the Space Station p 146 A87-32537  Status of the RITA - Experiment on EURECA Radio Frequency Ion Thrustor Assembly [AIAA PAPER 87-0988] p 123 A87-38002 The capabilities of Eureca thermal control for future mission scenarios [SAE PAPER 860936] p 42 A87-38725  Microgravity experiments onboard Eureca p 155 A87-53554 From Eureca-A to Eureca-B p 155 A87-535916 Botanical psyloads for platforms and space stations p 158 N87-25340 The evolution of a serviceable EURECA [MBB-UR-E-923/86] p 121 N87-26841 EURECA application of the Retractable Advanced Rigid Array (RARA) solar array p 82 N87-28973 Improved solar generator technology for the EURECA low Earth orbit p 159 N87-28973 Improved solar GaAs Array (ASGA) experiment on EURECA: Flight objectives and instrument configuration p 83 N87-28985  EUROPEAN SPACE AGENCY The Space Station overview p 168 A87-41571	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems for Space Station p 6 A87-33050  Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363  Mission scheduling expert system and its space station applications  [AIAA PAPER 87-2221] p 7 A87-48602  The Oak Ridge National Laboratory's Robotics and Intelligent Systems Program  [DE87-004627] p 101 N87-20774  Study of expert system applications to space projects (NE-51-867) p 115 N87-26057  Proceedings: Computer Science and Data Systems Technical Symposium, volume 1  [NASA-TM-89285] p 116 N87-29124  Proceedings: Computer Science and Data Systems Technical Symposium, volume 2  [NASA-TM-89286] p 116 N87-29144  EXPOSURE  Review of Low Earth Orbital (LEO) flight experiments p 131 N87-26178  EXPOSURE  Review of Low Earth Orbital (LEO) flight experiments p 108 N87-26175  Interaction of hyperthermal atoms on surfaces in orbit: The University of Alabama experiment  P 108 N87-26177  O-atom degradation mechanisms of materials  EXTENSIONS  EVALUATE EVALUATES  Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222  Astronomic Telescope Facility: Preliminary systems definition study report. Volume 2: Technical description [NASA-TM-89429-VOL-2] p 129 N87-22570
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft P 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197  EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rigid spacecraft [NASA-CR-181130] p 72 N87-26038  EURECA (ESA) Eureca - A first step towards the Space Station p 146 A87-32537  Status of the RITA - Experiment on EURECA Radio Frequency Ion Thrustor Assembly [AIAA PAPER 87-0988] p 123 A87-38002 The capabilities of Eureca thermal control for future mission scenarios [SAE PAPER 860936] p 42 A87-38725  Microgravity experiments onboard Eureca p 155 A87-53916 Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340 The evolution of a serviceable EURECA [MBB-UR-E-921/86] p 121 N87-26841 EURECA application of the Retractable Advanced Rigid Array (RARA) solar array p 82 N87-28973 Improved solar generator technology for the EURECA low Earth orbit p 159 N87-28974 Advanced Solar GaAs Array (ASGA) experiment on EURECA: Flight objectives and instrument configuration p 83 N87-28985  EUROPEAN SPACE AGENCY The Space Station overview p 168 A87-41571 ESA's future integrated space data system	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems — for Space Station p 6 A87-33050  Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363  Mission scheduling expert system and its space station applications  [AIAA PAPER 87-2221] p 7 A87-48602  The Oak Ridge National Laboratory's Robotics and Intelligent Systems Program  [DE87-004627] p 101 N87-20774  Study of expert system applications to space projects [NE-51-867] p 115 N87-26057  Proceedings: Computer Science and Data Systems Technical Symposium, volume 1  [NASA-TM-89285] p 116 N87-29124  Proceedings: Computer Science and Data Systems Technical Symposium, volume 2  [NASA-TM-89286] p 116 N87-29144  EXPOSURE  Review of Low Earth Orbital (LEO) flight experiments p 131 N87-26174  Material interactions with the Low Earth Orbital (LEO) environment: Accurate reaction rate measurements p 108 N87-26175  Interaction of hyperthermal atoms on surfaces in orbit: The University of Alabama experiment  P 108 N87-26177  O-atom degradation mechanisms of materials p 141 N87-26178  EXTENSIONS  Evaluation of carbon-carbon for space engine nozzle p 98 N87-26116  EXTRASOLAR PLANETS  Astrometric telescope of ten microarcsecond accuracy on the Space Station p 129 N87-22570  Astronomic Telescope Facility Preliminary systems definition study report. Volume 2: Technical description p 129 N87-22570  Astrometric Telescope Facility preliminary systems
experiment [AD-A182931] p 110 N87-29709  ESA SPACECRAFT Modal-survey testing of the Olympus spacecraft p 152 A87-42266  ESCAPE SYSTEMS A systems analysis of emergency escape and recovery systems for the US space station [AD-A179233] p 3 N87-23680  ESTIMATES Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A183302] p 11 N87-29893  ETCHING Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197  EULER EQUATIONS OF MOTION Minimum time attitude slewing maneuvers of a rigid spacecraft [NASA-CR-181130] p 72 N87-26038  EURECA (ESA) Eureca - A first step towards the Space Station p 146 A87-32537  Status of the RITA - Experiment on EURECA Radio Frequency Ion Thrustor Assembly [AIAA PAPER 87-0988] p 123 A87-38002 The capabilities of Eureca thermal control for future mission scenarios [SAE PAPER 860936] p 42 A87-38725  Microgravity experiments onboard Eureca p 155 A87-53554 From Eureca-A to Eureca-B p 155 A87-535916 Botanical psyloads for platforms and space stations p 158 N87-25340 The evolution of a serviceable EURECA [MBB-UR-E-923/86] p 121 N87-26841 EURECA application of the Retractable Advanced Rigid Array (RARA) solar array p 82 N87-28973 Improved solar generator technology for the EURECA low Earth orbit p 159 N87-28973 Improved solar GaAs Array (ASGA) experiment on EURECA: Flight objectives and instrument configuration p 83 N87-28985  EUROPEAN SPACE AGENCY The Space Station overview p 168 A87-41571	ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform	planning of research carried out from spacecraft p 160 N87-29553  EXPERT SYSTEMS  Expert systems in space p 111 A87-32075  An integrated analytic tool and knowledge-based system approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579  User interface design guidelines for expert troubleshooting systems for Space Station p 6 A87-33050  Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363  Mission scheduling expert system and its space station applications  [AIAA PAPER 87-2221] p 7 A87-48602  The Oak Ridge National Laboratory's Robotics and Intelligent Systems Program  [DE87-004627] p 101 N87-20774  Study of expert system applications to space projects (NE-51-867) p 115 N87-26057  Proceedings: Computer Science and Data Systems Technical Symposium, volume 1  [NASA-TM-89285] p 116 N87-29124  Proceedings: Computer Science and Data Systems Technical Symposium, volume 2  [NASA-TM-89286] p 116 N87-29144  EXPOSURE  Review of Low Earth Orbital (LEO) flight experiments p 131 N87-26178  EXPOSURE  Review of Low Earth Orbital (LEO) flight experiments p 108 N87-26175  Interaction of hyperthermal atoms on surfaces in orbit: The University of Alabama experiment  P 108 N87-26177  O-atom degradation mechanisms of materials  EXTENSIONS  EVALUATE EVALUATES  Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222  Astronomic Telescope Facility: Preliminary systems definition study report. Volume 2: Technical description [NASA-TM-89429-VOL-2] p 129 N87-22570

study

finite-element models

Dual keel space station control/structures interaction tudy p 67 N87-22737

Application of physical parameter identification to inite-element models p 34 N87-24505

# **EXTRATERRESTRIAL ENVIRONMENTS**

EXTRATERRESTRIAL ENVIRONMENTS  Space environmental effects on adhesives for the	FAST FOURIER TRANSFORMATIONS A modern approach for modal testing using multiple input	An analytical and experimental investigation of output feedback vs. linear quadratic regulator for large space
Galileo spacecraft p 139 A87-38643	sine excitation	structures [AIAA PAPER 87-2390] p 61 A87-50474
EXTRATERRESTRIAL RADIATION Radiation environments and absorbed dose estimations	[AIAA PAPER 87-0964] p 19 A87-33754  FASTENERS	A new concept of generalized structural filtering for
on manned space missions p 139 A87-49026 EXTRAVEHICULAR ACTIVITY	Joint technology for graphite epoxy space structures p 20 A87-38600	active vibration control synthesis [AIAA PAPER 87-2456] p 24 A87-50502
Multiple Access Ku-band communications subsystem for	FATIGUE (MATERIALS)	Aeroassisted orbital maneuvering using Lyapunov optimal feedback control
the Space Station p 84 A87-31462	Optimization of aerospace structures subjected to	[AIAA PAPER 87-2464] p 93 A87-50509
Space Station EVA simulation demonstrates orbital	random vibration and fatigue constraints p 29 N87-20599	Modeling and control of flexible structures
assembly p 132 A87-32006 Computer simulation of on-orbit manned maneuvering	FATIGUE LIFE	p 28 N87-20564
unit operations	Optimization of aerospace structures subjected to	Integrated control/structure design and robustness p 65 N87-22060
[SAE PAPER 861783] p 47 A87-32632	random vibration and fatigue constraints	Large space structures ground experiment checkout
Energy expenditure during simulated EVA workloads	p 29 N87-20599	p 30 N87-22704
[SAE PAPER 860921] p 163 A87-38713	FAULT TOLERANCE Autonomous decentralized system concept for Space	One Controller at a Time (1-CAT): A mimo design
Regenerable non-venting thermal control subsystem for extravehicular activity	Station p 146 A87-32541	methodology p 65 N87-22715
[SAE PAPER 860947] p 42 A87-38734	Space station electric power system requirements and	Flexible spacecraft simulator p 31 N87-22718 Improving stability margins in discrete-time LQG
Evaluation of regenerative portable life support system	design	controllers p 31 N87-22719
options - 40 A97 39735	[NASA-TM-89889] p 96 N87-22001	Control of flexible structures and the research
[SAE PAPER 860948] p 49 A87-38735	MAX: A space station computer option p 116 N87-29146	community p 66 N87-22732
Desirability of arms-in capability in space suits [SAE PAPER 860951] p 49 A87-38738	FEASIBILITY ANALYSIS	Maneuvering and vibration control of flexible spacecraft p 67 N87-22734
The development of an EVA Universal Work Station	Payload boomerang technology for space experiments	spacecraft p 67 N87-22734  Robust control for large space antennas
[SAE PAPER 860952] p 164 A87-38739	at very low gravity level p 146 A87-32540	p 87 N87-24499
Space Station EVA systems trade-off model	Feasibility study on 8PSK, QPSK, TFM, by using CLASS for Space Station/TDRSS real measured channel	Large space structures testing
[SAE PAPER 860990] p 134 A87-38767	p 113 A87-45485	[NASA-TM-100306] p 35 N87-24520
Physiological aspects of EVA [SAE PAPER 860991] p 164 A87-38768	FECES	Some problems in the control of large space
Advanced orbital servicing capabilities development	Electrochemical processing of solid waste	structures [AD-A179989] p 70 N87-25350
(SAF PAPER 860992) p 134 A87-38769	[NASA-CR-181128] p 137 N87-25443	Development of intelligent structures using finite control
An evaluation of options to satisfy Space Station EVA	FEDERAL BUDGETS Department of Housing and Urban	elements in a hierarchic and distributed control system
requirements [SAE PAPER 861008] p 134 A87-38780	Development-independent agencies appropriations for	[AD-A179711] p 72 N87-25805
An evaluation of advanced extravehicular crew	1988	FIBER COMPOSITES
enclosures	[GPO-73-418] p 171 N87-22560	Fiber composites in satellites [MBB-UD-492/86] p 107 N87-25430
[SAE PAPER 861009] p 134 A87-38781	National Aeronautics and Space Administration	FIBER OPTICS
Space Station EVA using a maneuvering enclosure	Authorization Act [S-REPT-100-87] p 171 N87-24240	Fiber-optic monitors for space structures
unit [SAE PAPER 861010] p 135 A87-38782	National Aeronautics and Space Administration	p 11 A87-31505 Star topology spacecraft data bus
The next step for the MMU - Capabilities and	Authorization Act, fiscal year 1988	p 112 A87-37431
enhancements 402 407 00783	[H-REPT-100-204] p 171 N87-25024 National Aeronautics and Space Administration	Proof that timing requirements of the FDDI token ring
[SAE PAPER 861013] p 160 A87-38783 On-board communications, including EVA	p 172 N87-30220	protocol are satisfied fiber distributed data interface
p 85 A87-40380	NASA authorization: Authorization of appropriations for	p 112 A87-42821
Dynamic behavior of astronauts and satellites outside	the National Aeronautics and Space Administration for	Information network architectures p 116 N87-29149 Fiber optics wavelength division
an orbiting space station under the influence of thrust	fiscal year 1988 (GPO-73-245) p 172 N87-30221	multiplexing(components) p 117 N87-29151
p 52 A87-41666	[GPO-73-245] p 1/2 N8/-30221 FEEDBACK CONTROL	Fiber optic data systems p 117 N87-29152
Advanced EVA system design requirements study: EVAS/space station system interface requirements	Vibration suppression using a constrained rate-feedback	Advanced local area network concepts p 117 N87-29153
[NASA-CR-171981] p 120 N87-20351	Threshold control strategy for large space structures	Fiber optics common transceiver module
A multiple attribute decision analysis of manned airlock	[AIAA PAPER 87-0741] p 6 A87-33665	p 117 N87-29160
systems (AD-A179241) p 137 N87-23682	Sensitivity of distributed structures to model order in feedback control	SS focused technology: Gateways and NOS's
[AD-A179241] p 137 N87-23662 Human factors in space station architecture 2. EVA	[AIAA PAPER 87-0900] p 56 A87-33710	p 117 N87-29165
access facility: A comparative analysis of 4 concepts for	Positive position feedback control for large space	Network operating system p 117 N87-29166 FIBER ORIENTATION
on-orbit space suit servicing	structures - 47 A97 99711	Development of graphite epoxy space structure
[NASA-TM-86856] p 52 N87-24064	[AIAA PAPER 87-0902] p 17 A87-33711 A comparison of active vibration control techniques -	p 105 A87-32342
Space suit extravehicular hazards protection	Output feedback vs optimal control	FINANCE
development [NASA-TM-89355] p 53 N87-27407	[AIAA PAPER 87-0904] p 56 A87-33713	National Aeronautics and Space Administration p 172 N87-30220
EXTRAVEHICULAR MOBILITY UNITS	Accuracy of derivatives of control performance using a	FINITE ELEMENT METHOD
Regenerable non-venting thermal control subsystem for	reduced structural model [AIAA PAPER 87-0905] p 57 A87-33714	Prediction of random vibrational responses of a large
extravehicular activity [SAE PAPER 860947] p 42 A87-38734	Adaptive tracking of dynamical model by uncertain	spacecraft in acoustic environment by BLPF method
Evaluation of regenerative portable life support system	nonlinearizable spacecraft	p 144 A87-32334 A modern approach for modal testing using multiple input
ootions	[AIAA PAPER 87-0940] p 57 A87-33738	sine excitation
[SAE PAPER 860948] p 49 A87-38735	Optimal vibration control by the use of piezoceramic	[AIAA PAPER 87-0964] p 19 A87-33754
An evaluation of options to satisfy Space Station EVA	sensors and actuators [AIAA PAPER 87-0959] p 18 A87-33751	A hybrid nonlinear programming method for design
requirements [SAE PAPER 861008] p 134 A87-38780	Space Station environmental control and life support	optimization p 7 A87-35718
Space Station EVA using a maneuvering enclosure	system distribution and loop closure studies	Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714
unit	[SAE PAPER 860942] p 48 A87-38729	Model reference adaptive control for large structural
[SAE PAPER 861010] p 135 A87-38782	Control of robot manipulator compliance p 100 A87-45797	systems p 63 A87-52973
EXTREMELY HIGH FREQUENCIES On-board K- and S-band multi-beam antennas	An approach to structure/control simultaneous	Modal-survey testing for system identification and
p 86 A87-46281	optimization for large flexible spacecraft	dynamic qualification of spacecraft structures p 27 N87-20365
	p 22 A87-46793	Modeling and control of flexible structures
F	Robust multivariable control of large space structures using positivity p 59 A87-47810	p 28 N87-20564
-	Modeling and control of torsional vibrations in a flexible	OPUS: Optimal Projection for Uncertain Systems
FACTORIZATION	structure p 60 A87-50033	[AD-A176820] p 29 N87-21025
Spectral factorization and homogenization methods for	Low-authority control of large space structures by using	Dynamic finite element modeling of flexible structures
modeling and control of flexible structures	tendon control system [AIAA PAPER 87-2249] p 60 A87-50413	[AD-A177168] p 30 N87-22252
[AD-A179726] p 35 N87-24517  FAILURE ANALYSIS	[AIAA PAPER 87-2249] p 60 A87-50413 Control of distributed structures with small	A general method for dynamic analysis of structures overview p 31 N87-22707
Development of a computer program to generate typical	nonproportional damping	Equivalent beam modeling using numerical reduction
measurement values for various systems on a space	[AIAA PAPER 87-2250] p 60 A87-50414	techniques p 32 N87-22725
station p 115 N87-26698	Robust eigensystem assignment for flexible structures	Structural dynamics system model reduction
FAILURE MODES	[AIAA PAPER 87-2252] p 23 A87-50416	p 32 N87-22727

Robust control of a large space antenna
[AIAA PAPER 87-2253] p 86 A87-50417
Suboptimal feedback vibration control of a beam with a proof-mass actuator — large space structures
[AIAA PAPER 87-2323] p 23 A87-50444

FAINT OBJECT CAMERA

Automatic generation of stochastically dominant failure modes for large-scale structures p 149 A87-37853

p 127 N87-20359

Qualification of the faint object camera

[NASA-CR-181065]

[AD-A179726]

p 34 N87-23980

p 35 N87-24517

Spectral factorization and homogenization methods for

modeling and control of flexible structures

Evaluation of on-line pulse control for vibration A comparison between IMSC, PI and MIMSC methods uppression in flexible spacecraft in controlling the vibration of flexible systems [NASA-CR-180391] p 70 N87-24513 [NASA-CR-181156] p 36 N87-25605 [AIAA PAPER 87-0925] Development of intelligent structures using finite control Development of intelligent structures using finite control elements in a hierarchic and distributed control system elements in a hierarchic and distributed control system with large rotations [AD-A179711] p 72 N87-25805 p 72 N87-25805 [AIAA PAPER 87-0930] Vibration control of flexible structures using piezoelectric evices as sensors and actuators p 37 N87-26387 FIRE PREVENTION Fire safety concerns in space operations devices as sensors and actuators [AIAA PAPER 87-0939] NASA-TM-89848] Projection filters for modal parameter estimate for p 165 N87-20342 FLEXIBILITY flexible structures Flexibility effects - Estimation of the stiffness matrix in [NASA-CR-180303] p 38 N87-26583 [AIAA PAPER 87-0940] An investigation of methodology for the control and the dynamics of a large structure p 23 A87-48714 **FLEXIBLE BODIES** failure identification of flexible structures Integrated control/structure design and robustness p 38 N87-26921 [AIAA PAPER 87-09431 [SAE PAPER 861821] Dynamic analysis of the flexible boom in the N-ROSS p 6 A87-32657 Static shape control for flexible structures
[SAE PAPER 861822] p 13 p 13 A87-32658 [AD-A1814881 p 72 N87-26966 [AIAA PAPER 87-0901] An identification method for flexible structures Computer simulation of a rotational single-element [AIAA PAPER 87-0745] p 16 A87-33669 flexible spacecraft boom Sensitivity of distributed structures to model order in [AD-A1817981 p 103 N87-26968 The effect of nonlinearities on flexible structures edback control [AIAA PAPER 87-09001 p 56 A87-33710 p 38 N87-27259 Gradient-based combined structural and control primization p 21 A87-40866 The dynamics and control of large flexible space structures X, part 1 Dynamics of a multibody system with relative translation [NASA-CR-181287] p 73 N87-27712 on curved, flexible tracks p 58 A87-40867 Modeling and computational algorithms for parameter Modeling, stabilization and control of serially connected estimation and optimal control of aeroelastic systems and large flexible structures On the inadequacies of current multi-flexible body [AD-A1833021 p 11 N87-29893 simulation codes FLEXIBLE SPACECRAFT [AIAA PAPER 87-2248] p 7 A87-50412 Robust controller design using frequency domain functions Robust eigensystem assignment for flexible structures constraints [AIAA PAPER 87-2252] Robust controller synthesis for a large flexible space p 23 A87-50416 Single-mode projection filters for identification and state estimation of flexible structures p 84 A87-32235 Configuration tradeoffs for the space infrared telescope [AIAA PAPER 87-2387] facility pointing control system p 121 A87-32236 A review of modelling techniques for the open and p 121 A87-32236 p 24 A87-50471 structure Adaptive identification of flexible structures by lattice filters closed-loop dynamics of large space systems [AIAA PAPER 87-2458] p 24 A87-50504 p 12 A87-32337 Dynamic and thermal effects in very large space Transient dynamics of orbiting flexible structural structures p 25 N87-20347 members p 54 A87-32338 A consideration to vibration control for a large space ructures p 54 A87-32441 Studies in nonlinear structural dynamics: Chaotic behavior and poynting effect p 26 N87-20348 Modeling and control of flexible structures Flexibility control of torsional vibrations of a large solar [AIAA PAPÉR 87-2238] p 28 N87-20564 p 12 A87-32442 array Air Force basic research in dynamics and control of Vibration control for a linked system of flexible large space structures p 63 N87-20577 structures A87-32444 p 55 NASA Modeling and control of flexible structures Precise pointing control of flexible spacecraft [AIAA PAPER 87-2321] [AD-A177106] p 29 N87-21388 p 55 A87-32446 Integrated control/structure design and robustness Control of flexible solar arrays with consideration of the p 65 N87-22060 actuator dynamics of the reaction wheel experiment for NASA Dynamic finite element modeling of flexible structures D 55 A87-32448 [AIAA PAPER 87-2322] [AD-A177168] p 30 N87-22252 Control of a flexible space manipulator Structural Dynamics and Control Interaction of Flexible p 99 A87-32449 Structures An assessment of recent advances in modeling and [NASA-CP-2467-PT-1] p 65 N87-22702 control design of space structures under uncertainty Status of the Mast experiment p 30 N87-22703 [SAE PAPER 861818] p 147 A87-32655 maneuvers Microprocessor controlled proof-mass actuator The Mast Flight System dynamic characteristics and [AIAA PAPER 87-2324] p 65 N87-22706 ctuator/sensor selection and location Space Station/Shuttle Orbiter dynamics during [AAS PAPER 86-003] p 13 A87-32729 [AIAA PAPER 87-2325] docking p 65 N87-22708 Instability of an elastic filament in orbit around a Considerations in the design and development of a control of flexible structures p 148 A87-32815 space station scale model gravitating center p 9 N87-22711 [AIAA PAPER 87-2461] Critical length for stable elongated orbiting structures p 148 A87-32819 Verification of large beam-type space structures p 31 N87-22712 Verification of flexible structures by ground test Control augmented structural synthesis with transient p 31 N87-22713 response constraints Status report and preliminary results of the spacecraft [AIAA PAPER 87-0749] p 56 A87-33573 spacecraft control laboratory experiment p 66 N87-22717 Simultaneous structure/control optimization of large Structural Dynamics and Control Interaction of Flexible flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 [AD-A175529] [NASA-CP-2467-PT-2] p 66 N87-22729 Optimization procedure to control the coupling of ribration modes in flexible space structures Vibration suppression by stiffness control p 66 N87-22730 [AIAA PAPER 87-0826] p 14 A87-33613 Control of flexible structures the research Some approximations for the dynamics of spacecraft community p 66 N87-22732 tethers Maneuvering and vibration control of flexible [AIAA PAPER 87-0821] p 122 A87-33687 p 67 spacecraft N87-22734 Experience in distributed parameter modeling of the A TREETOPS simulation of the Hubble Space flexible space structures Spacecraft Control Laboratory Experiment (SCOLE) Telescope-High Gain Antenna interaction structure р9 N87-22735 [AIAA PAPER 87-0895] p 16 A87-33689 Lanczos modes for reduced-order control of flexible On the control of flexible structures by applied thermal modal testing techniques p 33 N87-22739 Slewing control experiment for a flexible panel [AD-A176820] [AIAA PAPER 87-0887] p 78 N87-22740 p 16 A87-33706 Dynamic response of a viscoelastic Timoshenko beam Space station structural dynamics/reaction control [AIAA PAPER 87-0890] system interaction study p 67 N87-22753 p 16 A87-33708 An integrated, optimization-based approach to the Nonlinear transient analysis of joint dominated design and control of large space structures spacecraft [AD-A179459] p 34 N87-23683 [AIAA PAPER 87-0892] p 17 A87-33709 Flexible spacecraft simulator Modified independent modal space control method for Spillover stabilization and decentralized modal control active control of flexible systems of large space structures

[AIAA PAPER 87-0903]

reduced structural model

[AIAA PAPER 87-0905]

Accuracy of derivatives of control performance using a

p 17 A87-33712

p 57 A87-33714

Modal analyses of dynamics of a deformable multibody spacecraft - The Space Station: A continuum approach p 17 A87-33727 High speed simulation of multi-flexible-body systems p 57 A87-33730 Structural and control optimization of space structures p 17 A87-33737 Adaptive tracking of dynamical model by uncertain nonlinearizable spacecraft p 57 A87-33738 An experimental study of transient waves in a plane On a balanced passive damping and active vibration uppression of large space structures Control of flexible structures by applied thermal p 21 A87-39543 Deployment dynamics of space structures p 58 A87-40074 A formulation for studying dynamics of N connected flexible deployable members p 21 A87-41574 Attitude control of a spacecraft using an extended self-organizing fuzzy logic controller p 59 A87-41617 Interdisciplinary analysis procedures in the modeling and control of large space-based structures p 22 A87-42678 Flexible system model reduction and control system design based upon actuator and sensor influence p 59 A87-46301 An approach to structure/control simultaneous optimization for large flexible spacecraft p 22 A87-46793 Effects of atmosphere on slewing control of a flexible p 22 A87-47809 Dynamics of gyroelastic spacecraft p 59 A87-47811 Robust nonlinear attitude control of flexible spacecraft p 60 A87-48273 Modeling and control of torsional vibrations in a flexible p 60 A87-50033 Construction of positive real compensation for LSS - applied to Large Space Structure model p 60 A87-50404 Active damping control design for the COFS Mast Flight System --- Control of Flexible Structures program for p 23 A87-50442 Active vibration control synthesis for the COFS-I - A classical approach --- Control of Flexible Structures p 23 A87-50443 Suboptimal feedback vibration control of a beam with a proof-mass actuator --- large space structures
[AIAA PAPER 87-2323] p 23 A p 23 A87-50444 Control of multiple-mirror/flexible-structures in slew p 24 A87-50445 A laboratory simulation of flexible spacecraft control p 24 A87-50446 Practical issues in computation of optimal, distributed p 25 A87-50507 Tracking and pointing maneuvers deformation shaping [AIAA PAPER 87-2599] with slew-excited p 62 A87-50561 Equations of motion for maneuvering flexible pacecraft p 63 A87-52965 Mechanical Qualification of Large Flexible Spacecraft Future trends in spacecraft design and qualification p 2 N87-20356 Recent developments and future trends in structural dynamic design verification and qualification of large p 156 N87-20357 Dynamic modeling and optimal control design for large p 26 N87-20358 Structural qualification of large spacecraft p 26 N87-20361 Spacecraft qualification using advanced vibration and p 27 N87-20368 OPUS: Optimal Projection for Uncertain Systems p 29 N87-21025 Dynamics of flexible structures performing large overall motions: A geometrically-nonlinear approach p 64 N87-21335 Variable structure control system maneuvering of pacecraft p 64 N87-21989 p 31 N87-22718 An overview of controls research on the NASA Langley Research Center grid p 66 N87-22720 Precision pointing and control of flexible spacecraft p 66 N87-22723 Large spacecraft pointing and shape control

p 69 N87-24498

COFS 3 multibody dynamics and control technology p 69 N87-24506	Antenna Technology Shuttle Experiment (ATSE) p 87 N87-24508	[AIAA PAPER 87-1763] p 90 A87-45190
Ground test of large flexible structures	Computer modeling of high-voltage solar array	FLUID PRESSURE
p 34 N87-24510	experiment using the NASCAP/LEO (NASA Charging	Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger
Slew maneuvers on the SCOLE Laboratory Facility p 69 N87-24511	Analyzer Program/Low Earth Orbit) computer code [AD-A182589] p 81 N87-28186	[AIAA PAPER 87-1540] p 44 A87-44843
Suboptimal control of large flexible space structures	Test results from the solar array flight experiment	FLYWHEELS Intelligent flywheel energy storage units with additional
experiencing rotational dynamics nonlinearities [AD-A180606] p 71 N87-25352	p 83 N87-29010	functions for future space stations in near-earth orbits
[AD-A180606] p 71 N87-25352  Dynamics during thrust maneuvers of flexible spinning	FLIGHT TRAINING Soviet space stations as analogs, second edition	[DGLR PAPER 86-172] p 57 A87-36762
satellites with axial and radial booms p 71 N87-25355	[NASA-CR-180920] p 157 N87-21996	Application of advanced flywheel technology for energy storage on space station
Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356	FLOW DISTRIBUTION  Non-intrusive techniques for thermal measurements in	[DE87-007657] p 68 N87-24028
observation satellite p 71 N87-25356 A formulation for studying steady state/transient	microgravity fluid science experiments	Application of advanced flywheel technology for energy
dynamics of a large class of spacecraft and its	p 151 A87-39836	storage on space station p 74 N87-29933 FOLDING STRUCTURES
application p 35 N87-25357 Sampled nonlinear control for large angle maneuvers	Space station electrical power distribution analysis using a load flow approach p 80 N87-26699	Deployable surface truss concepts and two-dimensional
of flexible spacecraft p 71 N87-25358	FLUID DYNAMICS	adaptive structures p 144 A87-32341 Acoustic effects on the dynamic of lightweight
Active vibration damping of flexible structures using the traveling wave approach p 71 N87-25360	Non-intrusive techniques for thermal measurements in	structures p 28 N87-20372
traveling wave approach p 71 N87-25360  Maximum likelihood parameter identification of flexible	microgravity fluid science experiments p 151 A87-39836	Development of precision structural joints for large space
spacecraft	FLUID FLOW	structures p 28 N87-20374 Deployable geodesic truss structure
(ETN-87-90235) p 38 N87-27705 Study on investigation of the attitude control of large	Liquid sheet radiator [AIAA PAPER 87-1525] p 43 A87-43048	[NASA-CASE-LAR-13113-1] p 36 N87-25492
flexible spacecraft. Phase 1, volume 1: Technical report	Analytical and experimental modeling of zero/low gravity	The high performance solar array GSR3 p 81 N87-28972
[ESA-CR(P)-2361-VOL-1] p 73 N87-27706	fluid behavior [AIAA PAPER 87-1865] p 91 A87-45260	The extendable and retractable mast as supporting tool
Study on investigation of the attitude control of large flexible spacecraft. Phase 2, volume 1: Executive summary	[AIAA PAPER 87-1865] p 91 A87-45260 FLUID MANAGEMENT	for rigid solar arrays p 39 N87-29012
laboratory test model	A thermally-pumped heat transport system	Folding, articulated, square truss p 40 N87-29859
[ESA-CR(P)-2361-VOL-1] p 73 N87-27707	p 40 A87-32369 On-orbit fluid management p 132 A87-32543	FOOD Foods and nutrition in space
Study on the investigation of the attitude control of large flexible spacecraft. Phase 2, volume 2: Technical report	On-orbit fluid management p 132 A87-32543 Refueling satellites in space - The OSCRS program	[SAE PAPER 860926] p 47 A87-38716
laboratory test model	[SAE PAPER 861797] p 88 A87-32645	FOOD PRODUCTION (IN SPACE)  The growth and harvesting of algae in a micro-gravity
[ESA-CR(P)-2361-VOL-2] p 73 N87-27708 Study on investigation of the attitude control of large	Maintenance components for Space Station long life fluid systems	environment p 165 N87-20325
flexible spacecraft, phase 3	[SAE PAPER 861005] p 89 A87-38778	FRAGMENTATION
[ESA-CR(P)-2361-VOL-4] p 73 N87-27709	Space station active thermal control system modelling	Simulation of on-orbit satellite fragmentations p 140 N87-24515
FLEXING  Effect of bonding on the performance of a	[AIAA PAPER 87-1468] p 43 A87-43003 Development of a prototype two-phase thermal bus	Space station integrated wall design and penetration
piezoactuator-based active control system	system for Space Station	damage control. Task 3: Theoretical analysis of penetration
[NASA-CR-181414] p 74 N87-29713	[AIAA PAPER 87-1628] p 44 A87-43126 On-orbit cryogenic fluid management experimental data	mechanics [NASA-CR-179166] p 39 N87-28582
Optimum shape control of flexible beams by piezo-electric actuators	requirements using referee fluids	FRAMES
[NASA-CR-181413] p 40 N87-29898	[AIAA PAPER 87-1559] p 90 A87-44832	Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures
FLIGHT CHARACTERISTICS  Modeling of environmentally induced transients within	Space-based OTV boiloff disposition [AIAA PAPER 87-1767] p 91 A87-45191	spacecraft masts
satellites	Thermodynamic analysis and subscale modeling of	[NASA-CR-180317] p 38 N87-27260
[AIAA PAPER 85-0387] p 7 A87-41611	space-based orbit transfer vehicle cryogenic propellant	Computational procedures for evaluating the sensitivity derivatives of vibration frequencies and Eigenmodes of
FLIGHT CONTROL System level verification applying the Space Shuttle	resupply [AIAA PAPER 87-1764] p 92 A87-48572	framed structures
experience to the Space Station	Microgravity Fluid Management Symposium	[NASA-CR-4099] p 40 N87-29899 FREE VIBRATION
[AAS PAPER 86-001] p 55 A87-32727 Shuttle orbit flight control design lessons - Direction for	[NASA-ČP-2465] p 94 N87-21141 Advanced long term cryogenic storage systems	A Lanczos eigenvalue method on a parallel computer
Space Station p 58 A87-37295	p 94 N87-21142	for large complex space structure free vibration
Japanese space information system overview	Long term cryogenic storage facility systems study p 94 N87-21143	analysis [AIAA PAPER 87-0725] p 13 A87-33565
[AIAA PAPER 87-2191] p 153 A87-48579 OPUS: Optimal Projection for Uncertain Systems	Space station experiment definition: Long term cryogenic	Computational procedures for evaluating the sensitivity
[AD-A176820] p 29 N87-21025	fluid storage p 94 N87-21144	derivatives of vibration frequencies and Eigenmodes of framed structures
FLIGHT LOAD RECORDERS  Analysis of Intelsat V flight data	Helium technology issues p 94 N87-21145 Overview: Fluid acquisition and transfer	[NASA-CR-4099] p 40 N87-29899
[AIAA PAPER 87-0784] p 16 A87-33679	p 94 N87-21146	FREQUENCY CONTROL
FLIGHT MECHANICS	The coupled dynamics of fluids and spacecraft in low	Modeling and control of flexible structures [AD-A177106] p 29 N87-21388
System technology analysis of aeroassisted orbital transfer vehicles; Moderate lift/drag (0.75-1.5),volume 1B,	gravity and low gravity fluid measurement p 94 N87-21147	FREQUENCY DIVISION MULTIPLE ACCESS
part 1, study results	Numerical modelling of cryogenic propellant behavior	FDMA system design and analysis for Space Station p 85 A87-45483
[NASA-CR-179141] p 4 N87-26066	in low-G p 95 N87-21148 Mixing-induced fluid destratification and ullage	FREQUENCY MODULATION
FLIGHT OPERATIONS  Design and development of a Space Station proximity	condensation p 95 N87-21149	Feasibility study on 8PSK, QPSK, TFM, by using CLASS
operations research and development mockup	Cryogenic Fluid Management Flight Experiment	for Space Station/TDRSS real measured channel p 113 A87-45485
[SAE PAPER 861785] p 133 A87-32634 FLIGHT PATHS	(CFMFE) p 95 N87-21150 Superfluid helium on orbit transfer (SHOOT)	FREQUENCY RESPONSE
Singular perturbation analysis of AOTV related trajectory	p 95 N87-21151	Robust controller design using frequency domain
optimization problems	Microgravity fluid management in two-phase thermal systems p 95 N87-21152	constraints p 11 A87-32229 FREQUENCY SHIFT
[NASA-CR-180301] p 137 N87-26927 FLIGHT SIMULATORS	systems p 95 N87-21152  Microgravity fluid management requirements of	Frequency dispersion in the admittance of the
A simulation capability for future space flight	advanced solar dynamic power systems	polycrystalline Cu2S/CdS solar cell p 5 A87-29133 FRICTION
[SAE PAPER 861784] p 99 A87-32633  Documentation of the space station/aircraft acoustic	p 77 N87-21153 Maintenance evaluation for space station liquid	Self-calibration strategies for robot manipulators
apparatus	systems p 52 N87-21155	p 102 N87-26355
[NASA-TM-89111] p 140 N87-20795	Shuttle middeck fluid transfer experiment: Lessons	FUEL CELLS  Advanced technology for extended endurance alkaline
FLIGHT TESTS Laser docking system flight experiment	learned p 95 N87-21158 Thermodynamic analysis and subscale modeling of	fuel cells p 75 A87-33787
[AAS PAPER 86-043] p 99 A87-32745	space-based orbit transfer vehicle cryogenic propellant	FUEL TANKS  Townstature fields due to int induced mixing in a horizal
The Tethered Satellite System as a new remote sensing platform p 124 A87-39183	resupply [NASA-TM-89921] p 96 N87-22949	Temperature fields due to jet induced mixing in a typical OTV tank
platform p 124 A87-39183 Liquid droplet radiator development status waste heat	Space station experiment definition: Long-term	[AIAA PAPER 87-2017] p 93 A87-52247
rejection devices for future space vehicles	cryogenic fluid storage	Space station experiment definition: Long term cryogenic fluid storage p 94 N87-21144
[AIAA PAPER 87-1537] p 43 A87-43059 Liquid droplet radiator development status	[NASA-CR-4072] p 97 N87-24641 FLUID MECHANICS	Design and demonstrate the performance of cryogenic
[NASA-TM-89852] p 44 N87-20353	Symposium on Microgravity Fluid Mechanics,	components representative of space vehicles: Start basket
Use of a video-photogrammetry system for the	Proceedings of the Winter Annual Meeting, Anaheim, CA,	liquid acquisition device performance analysis [NASA-CR-179138] p 97 N87-26081
measurement of the dynamic response of the shuttle remote manipulator arm p 101 N87-20370	Dec. 7-12, 1986 p 89 A87-38785 U.S. National Congress of Applied Mechanics, 10th,	FUNCTIONAL DESIGN SPECIFICATIONS
SAFE/DAE: Modal test in space p 77 N87-20584	University of Texas, Austin, June 16-20, 1986,	Comparison of satellite support structure aluminum
Solar array flight dynamic experiment p 78 N87-22722	Proceedings [AD-A181962] p 1 A87-40051	versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279
D / 0 110/*22/22	[	

An astrometric facility for planetary detection on the Space Station p 127 A87-50750	The evolution of the geostationary platform concept	GROUND STATE
Space Station p 127 A87-50750 Working group on Earth observation requirements for	p 125 A87-43154 An advanced geostationary communications platform	Production of a beam of ground state oxygen atoms of selectable energy p 139 A87-38624
the Polar Orbiting Platform Elements of the International	p 125 A87-43165	GROUND TESTS
Space Station (the POPE Working Group)	The use of Pi2 pulsations as indicators of substorm effects at geostationary orbit p 142 N87-26842	Validation of large space structures by ground tests
p 128 N87-20625 End effector development study. Volume 2: Service End	effects at geostationary orbit p 142 N87-26942 LEO and GEO missions p 5 N87-29916	p 11 A87-32336
Effector subsystem specification (SEESSPEC)	GET AWAY SPECIALS (STS)	Modeling of environmentally induced transients within satellites
in-orbiting servicing	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306	[AIAA PAPER 85-0387] p 7 A87-41611
[FOK-TR-R-86-091-VOL-2] p 102 N87-24486 FUZZY SYSTEMS	Use of lightweight composites for GAS payload	Status of the Mast experiment p 30 N87-22703
Attitude control of a spacecraft using an extended	structures p 25 N87-20307	Verification of flexible structures by ground test p 31 N87-22713
self-organizing fuzzy logic controller p 59 A87-41617	Progress on the Ohio State University Get Away Special G-0318: DEAP p 170 N87-20311	Ground test of large flexible structures
^	The growth and harvesting of algae in a micro-gravity	p 34 N87-24510
G	environment p 165 N87-20325 GIMBALS	Preliminary design, analysis, and costing of a dynamic scale model of the NASA space station
GALACTIC COSMIC RAYS	The Softmounted Inertially Reacting Pointing System	[NASA-CR-4068] p 36 N87-25606
Radiation shielding requirements on long-duration space	(SIRPNT)	Development of experimental/analytical concepts for
missions [AD-A177512] p 140 N87-21991	[AAS PAPER 86-007] p 56 A87-32732	structural design verification spacecraft structures [ESA-CR(P)-2340] p 36 N87-26075
[AD-A177512] p 140 N87-21991  GALILEO SPACECRAFT	A study on singularity of single gimbal CMG systems p 149 A87-35077	Study on investigation of the attitude control of large
Space environmental effects on adhesives for the	GLASS FIBERS	flexible spacecraft. Phase 2, volume 1: Executive summary laboratory test model
Galileo spacecraft p 139 A87-38643 An electrically conductive thermal control surface for	Effects on advanced materials: Results of the STS-8 EOIM (Effects of Oxygen Interaction with Materials)	[ESA-CR(P)-2361-VOL-1] p 73 N87-27707
spacecraft encountering Low-Earth Orbit (LEO) atomic	experiment	Study on the investigation of the attitude control of large
oxygen indium tin oxide-coated thermal blankets	[AD-A182931] p 110 N87-29709	flexible spacecraft. Phase 2, volume 2: Technical report laboratory test model
p 45 N87-26192  GALLIUM ARSENIDES	GLIDE PATHS	[ESA-CR(P)-2361-VOL-2] p 73 N87-27708
GaAs concentrator solar arrays p 82 N87-28977	Optimal heading change with minimum energy loss for a hypersonic gliding vehicle	GROWTH
Advanced Solar GaAs Array (ASGA) experiment on	[AIAA PAPER 87-2568] p 136 A87-49618	The growth and harvesting of algae in a micro-gravity environment p 165 N87-20325
EURECA: Flight objectives and instrument configuration	GLOBAL POSITIONING SYSTEM	A method of variable spacing for controlled plant growth
p 83 N87-28985 GAME THEORY	Electric propulsion for orbit transfer - A NAVSTAR case study (Has electric propulsion's time come?)	systems in spaceflight and terrestrial agriculture
Problems of mechanical system configuration control	[AIAA PAPER 87-0985] p 88 A87-38001	applications [NASA-CR-177447] p 130 N87-25767
p 149 A87-35877 GAMMA RAY ASTRONOMY	GPS applications to the Space Station	[NASA-CR-177447] p 130 N87-25767 GYRATION
Status of orbital astronomy projects	p 136 A87-45525 GOES SATELLITES	Dynamics of gyroelastic spacecraft p 59 A87-47811
p 128 N87-21973	Planning for future operational sensors and other	GYROSCOPES  Perturbation analysis of internal balancing for lightly
High energy gamma ray astronomy	priorities [NOAA-NESDIS-30] p 130 N87-25560	damped mechanical systems with gyroscopic and
p 129 N87-24258  GAMMA RAY BURSTS	[NOAA-NESDIS-30] p 130 N87-25560  GOVERNMENT/INDUSTRY RELATIONS	circulatory forces p 22 A87-47812
The Signe II gamma-ray burst experiment aboard the	Space Station business p 169 A87-47726	GYROSCOPIC STABILITY
Prognoz 9 satellite p 150 A87-38443 GAMMA RAYS	GRAPHITE	Global treatment of energy dissipation effects for multibody satellites p 62 A87-51610
Mir in action p 150 A87-37971	Material damping in aluminum and metal matrix composites p 106 A87-49797	p = 1,0,0,0,0
GAS DENSITY	GRAPHITE-EPOXY COMPOSITES	Н
Resistojet plume and induced environment analysis	Development of graphite epoxy space structure	
[NASA-TM-88957] p 96 N87-24536	p 105 A87-32342	HABITABILITY
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a	p 105 A87-32342 Comparison of satellite support structure aluminum versus graphite epoxy	ISOKIN - A quantitative model of the kinesthetic aspects
[NASA-TM-88957] p 96 N87-24536 GAS EXCHANGE An evolutionary approach to the development of a CELSS based air revitalization system	p 105 A87-32342 Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968] p 49 A87-38750	p 105 A87-32342 Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station [SAE PAPER 860928] p 163 A87-38718
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a  CELSS based air revitalization system  [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment:	p 105 A87-32342 Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-38600 Microcrack resistant structural composite tubes for	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station [SAE PAPER 860928] p 163 A87-38718 Habitability issues for the Science Laboratory Module
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306	p 105 A87-32342 Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-36600 Microcrack resistant structural composite tubes for space applications p 106 A87-41022	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station [SAE PAPER 860928] p 163 A87-38718 Habitability issues for the Science Laboratory Module (SAE PAPER 860971) p 50 A87-38753 Space station group activities habitability module study
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE An evolutionary approach to the development of a CELSS based air revitalization system [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS	p 105 A87-32342 Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-38600 Microcrack resistant structural composite tubes for space applications p 106 A87-41022 Taylored laminates with null or arbitrary coefficient of	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station [SAE PAPER 860928] p 163 A87-38718 Habitability issues for the Science Laboratory Module [SAE PAPER 860971] p 50 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS  Proceedings of the NASA Workshop on Atomic Oxygen Effects low earth orbital environment	p 105 A87-32342 Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-36600 Microcrack resistant structural composite tubes for space applications p 106 A87-41022	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station  [SAE PAPER 860928] p 163 A87-38718 Habitability issues for the Science Laboratory Module [SAE PAPER 860971] p 50 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 HABITATS
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS  Proceedings of the NASA Workshop on Atomic Oxygen Effects low earth orbital environment  [NASA-CR-181163] p 141 N87-26173	p 105 A87-32342  Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279  Joint technology for graphite epoxy space structures p 20 A87-36800  Microcrack resistant structural composite tubes for space applications p 106 A87-41022  Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794  Box truss antenna technology status p 87 N87-24503	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station  [SAE PAPER 860928] p 163 A87-38718 Habitability issues for the Science Laboratory Module [SAE PAPER 860971] p 50 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 HABITATS  The undersea habitat as a space station analog: Evaluation of research and training potential
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS  Proceedings of the NASA Workshop on Atomic Oxygen Effects low earth orbital environment [NASA-CR-181163] p 141 N87-26173  Dynamics of atom-surface interactions	p 105 A87-32342 Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-36600 Microcrack resistant structural composite tubes for space applications p 106 A87-41022 Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 Box truss antenna technology status  P 87 N87-24503  GRAVITATION	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station  [SAE PAPER 860928] p 163 A87-38718 Habitability issues for the Science Laboratory Module [SAE PAPER 860971] p 50 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 HABITATS  The undersea habitat as a space station analog: Evaluation of research and training potential [NASA-CR-180342] p 53 N87-27405
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS  Proceedings of the NASA Workshop on Atomic Oxygen Effects low earth orbital environment  [NASA-CR-181163] p 141 N87-26173  Dynamics of atom-surface interactions  p 141 N87-26183  Laboratory studies of atomic oxygen reactions with	p 105 A87-32342 Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-38600 Microcrack resistant structural composite tubes for space applications p 106 A87-41022 Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 Box truss antenna technology status p 87 N87-24503  GRAVITATION Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station [SAE PAPER 860928] p 163 A87-38718 Habitability issues for the Science Laboratory Module [SAE PAPER 860971] p 50 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 HABITATS  The undersea habitat as a space station analog: Evaluation of research and training potential [NASA-CR-180342] p 53 N87-27405 HANDLING EQUIPMENT
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS  Proceedings of the NASA Workshop on Atomic Oxygen Effects low earth orbital environment [NASA-CR-181163] p 141 N87-26173  Dynamics of atom-surface interactions  p 141 N87-26183  Laboratory studies of atomic oxygen reactions with solids  p 4 N87-26185	p 105 A87-32342 Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-36800 Microcrack resistant structural composite tubes for space applications p 106 A87-41022 Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 Box truss antenna technology status  GRAVITATION Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573 GRAVITATIONAL EFFECTS	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station  [SAE PAPER 860928] p 163 A87-38718 Habitability issues for the Science Laboratory Module [SAE PAPER 860971] p 50 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 HABITATS  The undersea habitat as a space station analog: Evaluation of research and training potential [NASA-CR-180342] p 53 N87-27405 HANDLING EQUIPMENT  Remote handling facility and equipment used for space truss assembly
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS  Proceedings of the NASA Workshop on Atomic Oxygen Effects low earth orbital environment  [NASA-CR-181163] p 141 N87-26173  Dynamics of atom-surface interactions  p 141 N87-26183  Laboratory studies of atomic oxygen reactions with solids  Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197	Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-36800 Microcrack resistant structural composite tubes for space applications p 106 A87-41022 Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 Box truss antenna technology status  GRAVITATION Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573 GRAVITATIONAL EFFECTS Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station  [SAE PAPER 860928] p 163 A87-38718 Habitability issues for the Science Laboratory Module [SAE PAPER 860971] p 50 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 HABITATS  The undersea habitat as a space station analog: Evaluation of research and training potential [NASA-CR-180342] p 53 N87-27405 HANDLING EQUIPMENT  Remote handling facility and equipment used for space truss assembly [DE87-009121] p 103 N87-27408
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS  Proceedings of the NASA Workshop on Atomic Oxygen Effects low earth orbital environment [NASA-CR-181163] p 141 N87-26173  Dynamics of atom-surface interactions  p 141 N87-26183  Laboratory studies of atomic oxygen reactions with solids  Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197  Chemical interactions in Low Earth Orbit (LEO)	p 105 A87-32342 Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-36600 Microcrack resistant structural composite tubes for space applications p 106 A87-41022 Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 Box truss antenna technology status  GRAVITATION Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573 GRAVITATIONAL EFFECTS Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222 Dynamic and thermal effects in very large space	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station  [SAE PAPER 860928] p 163 A87-38718 Habitability issues for the Science Laboratory Module [SAE PAPER 860971] p 50 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 HABITATS  The undersea habitat as a space station analog: Evaluation of research and training potential [NASA-CR-180342] p 53 N87-27405 HANDLING EQUIPMENT  Remote handling facility and equipment used for space truss assembly
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS  Proceedings of the NASA Workshop on Atomic Oxygen Effects low earth orbital environment  [NASA-CR-181163] p 141 N87-26173  Dynamics of atom-surface interactions  p 141 N87-26183  Laboratory studies of atomic oxygen reactions with solids  Reactions of atomic oxygen (O(P-3)) with polybutacienes and related polymers  p 109 N87-26197  Chemical interactions in Low Earth Orbit (LEO)  p 109 N87-26198	p 105 A87-32342 Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-38600 Microcrack resistant structural composite tubes for space applications p 106 A87-41022 Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 Box truss antenna technology status p 87 N87-24503  GRAVITATION Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573  GRAVITATIONAL EFFECTS Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222 Dynamic and thermal effects in very large space structures p 25 N87-20347	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station  [SAE PAPER 860928] p 163 A87-38718 Habitability issues for the Science Laboratory Module (SAE PAPER 860971] p 50 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 HABITATS  The undersea habitat as a space station analog: Evaluation of research and training potential [NASA-CR-180342] p 53 N87-27405 HANDLING EQUIPMENT  Remote handling facility and equipment used for space truss assembly [DE87-009121] p 103 N87-27408 HANGARS  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS  Proceedings of the NASA Workshop on Atomic Oxygen Effects low earth orbital environment [NASA-CR-181163] p 141 N87-26173  Dynamics of atom-surface interactions  p 141 N87-26183  Laboratory studies of atomic oxygen reactions with solids  Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197  Chemical interactions in Low Earth Orbit (LEO)	p 105 A87-32342 Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-36600 Microcrack resistant structural composite tubes for space applications p 106 A87-41022 Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 Box truss antenna technology status  GRAVITATION Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573 GRAVITATIONAL EFFECTS Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222 Dynamic and thermal effects in very large space	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station  [SAE PAPER 860928] p 163 A87-38718 Habitability issues for the Science Laboratory Module (SAE PAPER 860971) p 50 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 HABITATS  The undersea habitat as a space station analog: Evaluation of research and training potential [NASA-CR-180342] p 53 N87-27405 HANDLING EQUIPMENT  Remote handling facility and equipment used for space truss assembly [DE87-009121] p 103 N87-27408 HANGARS  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534 HANKEL FUNCTIONS
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS Proceedings of the NASA Workshop on Atomic Oxygen Effects — low earth orbital environment [NASA-CR-181163] p 141 N87-26173  Dynamics of atom-surface interactions	Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-38600 Microcrack resistant structural composite tubes for space applications p 106 A87-41022 Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 Box truss antenna technology status p 87 N87-24503  GRAVITATION Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573  GRAVITATIONAL EFFECTS Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222 Dynamic and thermal effects in very large space structures p 25 N87-20347 Space station momentum management p 64 N87-20668 The results of a limited study of approaches to the	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station  [SAE PAPER 860928] p 163 A87-38718 Habitability issues for the Science Laboratory Module [SAE PAPER 860971] p 50 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 HABITATS  The undersea habitat as a space station analog: Evaluation of research and training potential [NASA-CR-180342] p 53 N87-27405 HANDLING EQUIPMENT  Remote handling facility and equipment used for space truss assembly [DE87-009121] p 103 N87-27408 HANGARS  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534 HANKEL FUNCTIONS  New time-domain identification technique for vibrating structures p 58 A87-40869
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS  Proceedings of the NASA Workshop on Atomic Oxygen Effects — low earth orbital environment  [NASA-CR-181163] p 141 N87-26173  Dynamics of atom-surface interactions  p 141 N87-26185  Laboratory studies of atomic oxygen reactions with solids  p 4 N87-26185  Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers  p 109 N87-26197  Chemical interactions in Low Earth Orbit (LEO)  p 109 N87-26198  Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams  p 109 N87-26200  Potential surfaces for O atom-polymer reactions	Comparison of satellite support structure aluminum versus graphite epoxy  [SAWE PAPER 1692] p 20 A87-36279  Joint technology for graphite epoxy space structures p 20 A87-36800  Microcrack resistant structural composite tubes for space applications p 106 A87-41022  Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794  Box truss antenna technology status p 87 N87-24503  GRAVITATION  Tether system and controlled gravity  [AAS PAPER 86-240] p 124 A87-38573  GRAVITATIONAL EFFECTS  Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222  Dynamic and thermal effects in very large space structures  Space station momentum management p 64 N87-20668  The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station  [SAE PAPER 860928] p 163 A87-38718 Habitability issues for the Science Laboratory Module (SAE PAPER 860971) p 50 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 HABITATS The undersea habitat as a space station analog: Evaluation of research and training potential [NASA-CR-180342] p 53 N87-27405 HANDLING EQUIPMENT  Remote handling facility and equipment used for space truss assembly [DE87-009121] p 103 N87-27408 HANGARS  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534 HANKEL FUNCTIONS  New time-domain identification technique for vibrating structures p 58 A87-40869 HARDWARE
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS Proceedings of the NASA Workshop on Atomic Oxygen Effects — low earth orbital environment [NASA-CR-181163] p 141 N87-26173  Dynamics of atom-surface interactions	Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-38600 Microcrack resistant structural composite tubes for space applications p 106 A87-41022 Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 Box truss antenna technology status p 87 N87-24503  GRAVITATION Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573  GRAVITATIONAL EFFECTS Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222 Dynamic and thermal effects in very large space structures p 25 N87-20347 Space station momentum management p 64 N87-20668 The results of a limited study of approaches to the	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station  [SAE PAPER 860928] p 163 A87-38718 Habitability issues for the Science Laboratory Module [SAE PAPER 860971] p 50 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 HABITATS  The undersea habitat as a space station analog: Evaluation of research and training potential [NASA-CR-180342] p 53 N87-27405 HANDLING EQUIPMENT  Remote handling facility and equipment used for space truss assembly [DE87-009121] p 103 N87-27408 HANGARS  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534 HANKEL FUNCTIONS  New time-domain identification technique for vibrating structures p 58 A87-40869 HARDWARE  Space Station galley design
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS  Proceedings of the NASA Workshop on Atomic Oxygen Effects low earth orbital environment [NASA-CR-181163] p 141 N87-26173  Dynamics of atom-surface interactions p 141 N87-26183  Laboratory studies of atomic oxygen reactions with solids Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197  Chemical interactions in Low Earth Orbit (LEO) p 109 N87-26198  Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams p 109 N87-26200  Potential surfaces for O atom-polymer reactions  p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26206	Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-38600 Microcrack resistant structural composite tubes for space applications p 106 A87-41022 Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 Box truss antenna technology status p 87 N87-24503  GRAVITATION Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573  GRAVITATIONAL EFFECTS Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222 Dynamic and thermal effects in very large space structures p 25 N87-20347 Space station momentum management p 64 N87-20668 The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary [NASA-CR-178276] p 8 N87-21020 Equations of motion of a space station with emphasis	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station  [SAE PAPER 860928] p 163 A87-38718 Habitability issues for the Science Laboratory Module (SAE PAPER 860971) p 50 A87-38753 Space station group activities habitability module study (NASA-CR-4010) p 165 N87-21585 HABITATS  The undersea habitat as a space station analog: Evaluation of research and training potential (NASA-CR-80342) p 53 N87-27405 HANDLING EQUIPMENT  Remote handling facility and equipment used for space truss assembly (DE87-009121) p 103 N87-27408 HANGARS  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534 HANKEL FUNCTIONS  New time-domain identification technique for vibrating structures p 58 A87-40869 HARDWARE  Space Station galley design [SAE PAPER 860932] p 119 A87-38722 Materials for space applications p 166 A87-44741
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS  Proceedings of the NASA Workshop on Atomic Oxygen Effects low earth orbital environment [NASA-CR-181163] p 141 N87-26173  Dynamics of atom-surface interactions  p 141 N87-26183  Laboratory studies of atomic oxygen reactions with solids  Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26187  Chemical interactions in Low Earth Orbit (LEO)  p 109 N87-26198  Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams  p 109 N87-26200  Potential surfaces for O atom-polymer reactions  p 109 N87-26201  Comments on the interaction of materials with atomic oxygen  GASEOUS ROCKET PROPELLANTS	Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-36600 Microcrack resistant structural composite tubes for space applications p 106 A87-41022 Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 Box truss antenna technology status p 87 N87-24503  GRAVITATION Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573  GRAVITATIONAL EFFECTS Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222 Dynamic and thermal effects in very large space structures p 25 N87-20347 Space station momentum management  The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary [NASA-CR-178276] p 8 N87-21020 Equations of motion of a space station with emphasis on the effects of the gravity gradient	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station  [SAE PAPER 860928] p 163 A87-38718 Habitability issues for the Science Laboratory Module [SAE PAPER 860971] p 50 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 HABITATS  The undersea habitat as a space station analog: Evaluation of research and training potential [NASA-CR-180342] p 53 N87-27405 HANDLING EQUIPMENT  Remote handling facility and equipment used for space truss assembly [DE87-009121] p 103 N87-27408 HANGARS  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534 HANKEL FUNCTIONS  New time-domain identification technique for vibrating structures p 58 A87-40869 HARDWARE  Space Station galley design [SAE PAPER 860932] p 119 A87-38722 Materials for space applications HARDWARE UTILIZATION LISTS
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS  Proceedings of the NASA Workshop on Atomic Oxygen Effects low earth orbital environment  [NASA-CR-181163] p 141 N87-26173  Dynamics of atom-surface interactions p 141 N87-26183  Laboratory studies of atomic oxygen reactions with solids  Reactions of atomic oxygen (O(P-3)) with polybutaclienes and related polymers p 109 N87-26187  Chemical interactions in Low Earth Orbit (LEO) p 109 N87-26197  Chemical interactions of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams p 109 N87-26200  Potential surfaces for O atom-polymer reactions p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26206  GASEOUS ROCKET PROPELLANTS  Hydrogen-oxygen thruster with no products of combustion in exhaust plume	Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-36600 Microcrack resistant structural composite tubes for space applications p 106 A87-41022 Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 Box truss antenna technology status  GRAVITATION Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573 GRAVITATIONAL EFFECTS Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222 Dynamic and thermal effects in very large space structures p 25 N87-20347 Space station momentum management p 64 N87-20668 The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary [NASA-CR-178276] p 8 N87-21020 Equations of motion of a space station with emphasis on the effects of the gravity gradient [NASA-TM-86588] p 64 N87-21993	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station  [SAE PAPER 860928] p 163 A87-38718 Habitability issues for the Science Laboratory Module [SAE PAPER 860971] p 50 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 HABITATS  The undersea habitat as a space station analog: Evaluation of research and training potential [NASA-CR-180342] p 53 N87-27405 HANDLING EQUIPMENT  Remote handling facility and equipment used for space truss assembly [DE87-009121] p 103 N87-27408 HANGARS  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534 HANKEL FUNCTIONS  New time-domain identification technique for vibrating structures p 58 A87-40869 HARDWARE  Space Station galley design [SAE PAPER 860932] p 119 A87-38722 Materials for space applications hARDWARE UTILIZATION LISTS  An evaluation of menu systems for Space Station
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS  Proceedings of the NASA Workshop on Atomic Oxygen Effects low earth orbital environment [NASA-CR-181163] p 141 N87-26173  Dynamics of atom-surface interactions  p 141 N87-26183  Laboratory studies of atomic oxygen reactions with solids  Reactions of atomic oxygen (O(P-3)) with polybutacienes and related polymers p 109 N87-26187  Chemical interactions in Low Earth Orbit (LEO)  p 109 N87-26198  Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams  p 109 N87-26200  Potential surfaces for O atom-polymer reactions  p 109 N87-26201  Comments on the interaction of materials with atomic oxygen  GASEOUS ROCKET PROPELLANTS  Hydrogen-oxygen thruster with no products of combustion in exhaust plume [AIAA PAPER 87-1775] p 91 A87-45196	Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-36600 Microcrack resistant structural composite tubes for space applications p 106 A87-41022 Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 Box truss antenna technology status p 87 N87-24503  GRAVITATION Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573  GRAVITATIONAL EFFECTS Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222 Dynamic and thermal effects in very large space structures p 25 N87-20347 Space station momentum management  The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary [NASA-CR-178276] p 8 N87-21020 Equations of motion of a space station with emphasis on the effects of the gravity gradient	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station  [SAE PAPER 860928] p 163 A87-38718 Habitation imodule for the Space Station p 50 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 HABITATS  The undersea habitat as a space station analog: Evaluation of research and training potential [NASA-CR-180342] p 53 N87-27405 HANDLING EQUIPMENT  Remote handling facility and equipment used for space truss assembly [DE87-009121] p 103 N87-27408 HANGARS  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534 HANKEL FUNCTIONS  New time-domain identification technique for vibrating structures p 58 A87-40869 HARDWARE  Space Station galley design [SAE PAPER 860932] p 119 A87-38722 p 106 A87-44741 HARDWARE UTILIZATION LISTS  An evaluation of menu systems for Space Station p 111 A87-33040 HARMONIC EXCITATION
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS  Proceedings of the NASA Workshop on Atomic Oxygen Effects — low earth orbital environment [NASA-CR-181163] p 141 N87-26173 Dynamics of atom-surface interactions  p 141 N87-26183  Laboratory studies of atomic oxygen reactions with solids  p 4 N87-26185  Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers  p 109 N87-26197  Chemical interactions in Low Earth Orbit (LEO)  p 109 N87-26198  Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams  p 109 N87-26200  Potential surfaces for O atom-polymer reactions  p 109 N87-26201  Comments on the interaction of materials with atomic oxygen  GASEOUS ROCKET PROPELLANTS  Hydrogen-oxygen thruster with no products of combustion in exhaust plume [AIAA PAPER 87-1775] p 91 A87-45196	Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-36600 Microcrack resistant structural composite tubes for space applications p 106 A87-41022 Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 Box truss antenna technology status p 87 N87-24503  GRAVITATION Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573  GRAVITATIONAL EFFECTS Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222 Dynamic and thermal effects in very large space structures p 25 N87-20347 Space station momentum management p 64 N87-20668 The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary [NASA-CR-178276] p 8 N87-21020 Equations of motion of a space station with emphasis on the effects of the gravity gradient [NASA-TM-86588] p 64 N87-21993 Verification of large beam-type space structures p 31 N87-22712 Phase 3 study of selected tether applications in space.	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station  [SAE PAPER 860928] p 163 A87-38718 Habitation imodule for the Science Laboratory Module p 164 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 A87-21585 The undersea habitat as a space station analog: Evaluation of research and training potential [NASA-CR-180342] p 53 N87-27405 HANDLING EQUIPMENT  Remote handling facility and equipment used for space truss assembly [DE87-009121] p 103 N87-27408 HANGARS  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534 HANKEL FUNCTIONS  New time-domain identification technique for vibrating structures p 58 A87-40869 HARDWARE Space Station galley design [SAE PAPER 860932] p 119 A87-38722 Materials for space applications hARDWARE UTILIZATION LISTS  An evaluation of menu systems for Space Station interfaces p 111 A87-33040 HARMONIC EXCITATION  The effect of nonlinearities on flexible structures
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS  Proceedings of the NASA Workshop on Atomic Oxygen Effects low earth orbital environment [NASA-CR-181163] p 141 N87-26173  Dynamics of atom-surface interactions  p 141 N87-26183  Laboratory studies of atomic oxygen reactions with solids Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26187  Chemical interactions in Low Earth Orbit (LEO)  p 109 N87-26207  Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams  p 109 N87-26200  Potential surfaces for O atom-polymer reactions  p 109 N87-26201  Comments on the interaction of materials with atomic oxygen  GASEOUS ROCKET PROPELLANTS  Hydrogen-oxygen thruster with no products of combustion in exhaust plume [AIAA PAPER 87-1775] p 91 A87-45196  GASES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity	Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-36600 Microcrack resistant structural composite tubes for space applications p 106 A87-41022 Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 Box truss antenna technology status  GRAVITATION Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573 GRAVITATIONAL EFFECTS Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222 Dynamic and thermal effects in very large space structures p 25 N87-20347 Space station momentum management p 64 N87-20668 The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary [NASA-CR-178276] p 8 N87-21020 Equations of motion of a space station with emphasis on the effects of the gravity gradient [NASA-TM-86588] p 64 N87-21993 Verification of large beam-type space structures p 31 N87-22712 Phase 3 study of selected tether applications in space.	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station  [SAE PAPER 860928] p 163 A87-38718 Habitation immodule for the Science Laboratory Module PAPER 860971] p 50 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 HABITATS  The undersea habitat as a space station analog: Evaluation of research and training potential [NASA-CR-180342] p 53 N87-27405 HANDLING EQUIPMENT  Remote handling facility and equipment used for space truss assembly [DE87-009121] p 103 N87-27408 HANGARS  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534 HANKEL FUNCTIONS  New time-domain identification technique for vibrating structures p 58 A87-40869 HARDWARE  Space Station galley design [SAE PAPER 860932] p 119 A87-38722 Materials for space applications HARDWARE UTILIZATION LISTS  An evaluation of menu systems for Space Station interfaces p 111 A87-33040 HARMONIC EXCITATION  The effect of nonlinearities on flexible structures [AD-A181735] p 38 N87-27259
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS  Proceedings of the NASA Workshop on Atomic Oxygen Effects — low earth orbital environment [NASA-CR-181163] p 141 N87-26173 Dynamics of atom-surface interactions  p 141 N87-26183  Laboratory studies of atomic oxygen reactions with solids  p 4 N87-26186  Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers  p 109 N87-26197  Chemical interactions in Low Earth Orbit (LEO)  p 109 N87-26198  Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams  p 109 N87-26200  Potential surfaces for O atom-polymer reactions  p 109 N87-26201  Comments on the interaction of materials with atomic oxygen  GASEOUS ROCKET PROPELLANTS  Hydrogen-oxygen thruster with no products of combustion in exhaust plume [AIAA PAPER 87-1775] p 91 A87-45196  GASES  Gas and water recycling system for IOC vivarium experiments — Initial Operational Capacity  p 46 A87-32457	Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-36600 Microcrack resistant structural composite tubes for space applications p 106 A87-41022 Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 Box truss antenna technology status p 87 N87-24503  GRAVITATION Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573  GRAVITATIONAL EFFECTS Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222 Dynamic and thermal effects in very large space structures p 25 N87-20347 Space station momentum management p 64 N87-20668 The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary [NASA-CR-178276] p 8 N87-21020 Equations of motion of a space station with emphasis on the effects of the gravity gradient [NASA-TM-86588] p 64 N87-21993 Verification of large beam-type space structures p 31 N87-22712 Phase 3 study of selected tether applications in space.	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station  [SAE PAPER 860928] p 163 A87-38718 Habitation imodule for the Science Laboratory Module p 50 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 M87-21585 The undersea habitat as a space station analog: Evaluation of research and training potential [NASA-CR-180342] p 53 N87-27405 HANDLING EQUIPMENT  Remote handling facility and equipment used for space truss assembly [DE87-009121] p 103 N87-27408 HANGARS  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534 HANKEL FUNCTIONS  New time-domain identification technique for vibrating structures p 58 A87-40869 HARDWARE Space Station galley design [SAE PAPER 860932] p 119 A87-38722 Materials for space applications p 106 A87-44741 HARDWARE UTILIZATION LISTS  An evaluation of menu systems for Space Station interfaces p 111 A87-33040 HARMONIC EXCITATION  The effect of nonlinearities on flexible structures [AD-A181735] p 38 N87-27259 HARMONIC OSCILLATION  The effect of nonlinearities on flexible structures
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS  Proceedings of the NASA Workshop on Atomic Oxygen Effects low earth orbital environment [NASA-CR-181163] p 141 N87-26173  Dynamics of atom-surface interactions  p 141 N87-26183  Laboratory studies of atomic oxygen reactions with solids p 4 N87-26186  Reactions of atomic oxygen (O(P-3)) with polybutaclienes and related polymers p 109 N87-26197  Chemical interactions in Low Earth Orbit (LEO)  g 109 N87-26198  Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams p 109 N87-26200  Potential surfaces for O atom-polymer reactions  p 109 N87-26201  Comments on the interaction of materials with atomic oxygen  GASEOUS ROCKET PROPELLANTS  Hydrogen-oxygen thruster with no products of combustion in exhaust plume [AIAA PAPER 87-1775] p 91 A87-45196  GASES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity  p 46 A87-32457  A simulation model for the analysis of Space Station	Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-36600 Microcrack resistant structural composite tubes for space applications p 106 A87-41022 Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 Box truss antenna technology status p 87 N87-24503  GRAVITATION Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573  GRAVITATIONAL EFFECTS Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222 Dynamic and thermal effects in very large space structures p 25 N87-20347 Space station momentum management p 64 N87-20668 The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary [NASA-CR-178276] p 8 N87-21020 Equations of motion of a space station with emphasis on the effects of the gravity gradient [NASA-TM-86588] p 64 N87-21993 Verification of large beam-type space structures p 31 N87-22712 Phase 3 study of selected tether applications in space. Volume 1: Executive summary [NASA-CR-179185] p 131 N87-29585 GRAVITATIONAL FIELDS Optimal shuttle altitude changes using tethers	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station  [SAE PAPER 860928] p 163 A87-38718 Habitation immodule for the Space Station p 164 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 HABITATS  The undersea habitat as a space station analog: Evaluation of research and training potential [NASA-CR-180342] p 53 N87-27405 HANDLING EQUIPMENT  Remote handling facility and equipment used for space truss assembly [DE87-009121] p 103 N87-27408 HANGARS  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534 HANKEL FUNCTIONS  New time-domain identification technique for vibrating structures p 58 A87-40869 HARDWARE  Space Station galley design [SAE PAPER 860932] p 119 A87-38722 Materials for space applications HARDWARE UTILIZATION LISTS  An evaluation of menu systems for Space Station interfaces p 111 A87-33040 HARMONIC EXCITATION  The effect of nonlinearities on flexible structures [AD-A181735] p 38 N87-27259 HARMONIC OSCILLATION  The effect of nonlinearities on flexible structures [AD-A181735] p 38 N87-27259
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS  Proceedings of the NASA Workshop on Atomic Oxygen Effects — low earth orbital environment [NASA-CR-181163] p 141 N87-26173  Dynamics of atom-surface interactions  p 141 N87-26183  Laboratory studies of atomic oxygen reactions with solids  p 4 N87-26185  Reactions of atomic oxygen (O(P-3)) with polybutaclienes and related polymers  p 109 N87-26197  Chemical interactions in Low Earth Orbit (LEO)  p 109 N87-26197  Chemical interactions of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams  p 109 N87-26200  Potential surfaces for O atom-polymer reactions  p 109 N87-26201  Comments on the interaction of materials with atomic oxygen  GASEOUS ROCKET PROPELLANTS  Hydrogen-oxygen thruster with no products of combustion in exhaust plume [AIAA PAPER 87-1775] p 91 A87-45196  GASEO  Gas and water recycling system for IOC vivarium experiments — Initial Operational Capacity  p 46 A87-32457  A simulation model for the analysis of Space Station gas-phase trace contaminants  GEOLOGY	Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-38600 Microcrack resistant structural composite tubes for space applications p 106 A87-41022 Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 Box truss antenna technology status  GRAVITATION Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573 GRAVITATIONAL EFFECTS Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222 Dynamic and thermal effects in very large space structures p 25 N87-20347 Space station momentum management p 64 N87-20668 The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary [NASA-CR-178276] p 8 N87-21020 Equations of motion of a space station with emphasis on the effects of the gravity gradient [NASA-TM-86588] p 64 N87-21993 Verification of large beam-type space structures p 31 N87-22712 Phase 3 study of selected tether applications in space. Volume 1: Executive summary [NASA-CR-179185] p 131 N87-29585 GRAVITATIONAL FIELDS Optimal shuttle altitude changes using tethers [AD-A179205] p 189 N87-22756	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station [SAE PAPER 860928] p 163 A87-38718 Habitation imodule for the Space Station p 50 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 HABITATS  The undersea habitat as a space station analog: Evaluation of research and training potential [NASA-CR-180342] p 53 N87-27405 HANDLING EQUIPMENT  Remote handling facility and equipment used for space truss assembly [DE87-009121] p 103 N87-27408 HANGARS  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534 HANKEL FUNCTIONS  New time-domain identification technique for vibrating structures p 58 A87-40869 HARDWARE Space Station galley design [SAE PAPER 860932] p 119 A87-38722 p 106 A87-44741 HARDWARE UTILIZATION LISTS  An evaluation of menu systems for Space Station p 111 A87-33040 HARMONIC EXCITATION  The effect of nonlinearities on flexible structures p 9 8 N87-27259 HARMONIC OSCILLATION  The effect of nonlinearities on flexible structures [AD-A181735] p 38 N87-27259 HAZARDS
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS  Proceedings of the NASA Workshop on Atomic Oxygen Effects low earth orbital environment [NASA-CR-181163] p 141 N87-26173  Dynamics of atom-surface interactions  p 141 N87-26183  Laboratory studies of atomic oxygen reactions with solids  p 4 N87-26186  Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers  p 109 N87-26197  Chemical interactions in Low Earth Orbit (LEO)  p 109 N87-26198  Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams  p 109 N87-26200  Potential surfaces for O atom-polymer reactions  p 109 N87-26201  Comments on the interaction of materials with atomic oxygen  GASEOUS ROCKET PROPELLANTS  Hydrogen-oxygen thruster with no products of combustion in exhaust plume [AIAA PAPER 87-1775] p 91 A87-45196  GASES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity  p 46 A87-32457  A simulation model for the analysis of Space Station gas-phase trace contaminants  p 52 A87-53979  GEOLOGY  Solid Earth panel report Columbus program	Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-36800 Microcrack resistant structural composite tubes for space applications p 106 A87-41022 Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 Box truss antenna technology status p 87 N87-24503  GRAVITATION Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573  GRAVITATIONAL EFFECTS Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222 Dynamic and thermal effects in very large space structures Space station momentum management p 64 N87-20347 Space station momentum management p 64 N87-20668 The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary [NASA-CR-178276] p 8 N87-21020 Equations of motion of a space station with emphasis on the effects of the gravity gradient [NASA-TM-86588] p 64 N87-21993 Verification of large beam-type space structures p 31 N87-22712 Phase 3 study of selected tether applications in space. Volume 1: Executive summary [NASA-CR-179185] p 131 N87-29585 GRAVITATIONAL FIELDS Optimal shuttle altitude changes using tethers [AD-A179205] p 129 N87-22756	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station  [SAE PAPER 860928] p 163 A87-38718 Habitation immodule for the Space Station p 50 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 HABITATS  The undersea habitat as a space station analog: Evaluation of research and training potential [NASA-CR-180342] p 53 N87-27405 HANDLING EQUIPMENT  Remote handling facility and equipment used for space truss assembly [DEB7-009121] p 103 N87-27408 HANGARS  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534 HANKEL FUNCTIONS  New time-domain identification technique for vibrating structures p 58 A87-40869 HARDWARE  Space Station galley design [SAE PAPER 860932] p 119 A87-38722 Materials for space applications HARDWARE UTILIZATION LISTS  An evaluation of menu systems for Space Station interfaces p 111 A87-33040 HARMONIC EXCITATION  The effect of nonlinearities on flexible structures [AD-A181735] p 38 N87-27259 HARMONIC OSCILLATION  The effect of nonlinearities on flexible structures [AD-A181735] p 38 N87-27259 HAZARDS  Simulation of on-orbit satellite fragmentations p 140 N87-24515
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS  Proceedings of the NASA Workshop on Atomic Oxygen Effects — low earth orbital environment [NASA-CR-181163] p 141 N87-26173  Dynamics of atom-surface interactions  p 141 N87-26183  Laboratory studies of atomic oxygen reactions with solids  p 4 N87-26185  Reactions of atomic oxygen (O(P-3)) with polybutaclienes and related polymers  p 109 N87-26197  Chemical interactions in Low Earth Orbit (LEO)  p 109 N87-26197  Chemical interactions of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams  p 109 N87-26200  Potential surfaces for O atom-polymer reactions  p 109 N87-26201  Comments on the interaction of materials with atomic oxygen  GASEOUS ROCKET PROPELLANTS  Hydrogen-oxygen thruster with no products of combustion in exhaust plume [AIAA PAPER 87-1775] p 91 A87-45196  GASEO  Gas and water recycling system for IOC vivarium experiments — Initial Operational Capacity  p 46 A87-32457  A simulation model for the analysis of Space Station gas-phase trace contaminants  GEOLOGY	Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-38600 Microcrack resistant structural composite tubes for space applications p 106 A87-41022 Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 Box truss antenna technology status  GRAVITATION Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573 GRAVITATIONAL EFFECTS Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222 Dynamic and thermal effects in very large space structures p 25 N87-20347 Space station momentum management p 64 N87-20668 The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary [NASA-CR-178276] p 8 N87-21020 Equations of motion of a space station with emphasis on the effects of the gravity gradient [NASA-TM-86588] p 64 N87-21993 Verification of large beam-type space structures p 31 N87-22712 Phase 3 study of selected tether applications in space. Volume 1: Executive summary [NASA-CR-179185] p 131 N87-29585 GRAVITATIONAL FIELDS Optimal shuttle altitude changes using tethers [AD-A179205] p 189 N87-22756	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station  [SAE PAPER 860928] p 163 A87-38718 Habitability issues for the Science Laboratory Module [SAE PAPER 860971] p 50 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 HABITATS  The undersea habitat as a space station analog: Evaluation of research and training potential [NASA-CR-80342] p 53 N87-27405 HANDLING EQUIPMENT  Remote handling facility and equipment used for space truss assembly [DE87-099121] p 103 N87-27408 HANGARS  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534 HANKEL FUNCTIONS  New time-domain identification technique for vibrating structures p 58 A87-40869 HARDWARE  Space Station galley design [SAE PAPER 860932] p 119 A87-38722 Materials for space applications p 106 A87-44741 HARDWARE UTILIZATION LISTS  An evaluation of menu systems for Space Station interfaces p 111 A87-33040 HARMONIC EXCITATION  The effect of nonlinearities on flexible structures [AD-A181735] p 38 N87-27259 HARMONIC OSCILLATION  The effect of nonlinearities on flexible structures [AD-A181735] p 38 N87-27259 HAZARDS  Simulation of on-orbit satellite fragmentations p 140 N87-24515
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS  Proceedings of the NASA Workshop on Atomic Oxygen Effects — low earth orbital environment [NASA-CR-181163] Dynamics of atom-surface interactions  p 141 N87-26183  Laboratory studies of atomic oxygen reactions with solids p 4 N87-26186  Reactions of atomic oxygen (O(P-3)) with polybutaclienes and related polymers  p 109 N87-26197  Chemical interactions in Low Earth Orbit (LEO) p 109 N87-26198  Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams p 109 N87-26200  Potential surfaces for O atom-polymer reactions p 109 N87-26201  Comments on the interaction of materials with atomic oxygen GASEOUS ROCKET PROPELLANTS  Hydrogen-oxygen thruster with no products of combustion in exhaust plume [AIAA PAPER 87-1775] p 91 A87-45196  GASES  Gas and water recycling system for IOC vivarium experiments — Initial Operational Capacity p 46 A87-32457 A simulation model for the analysis of Space Station gas-phase trace contaminants p 52 A87-53979  GEONAGNETIC MICROPULSATIONS  The use of Pi2 pulsations as indicators of substorm	Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-36800 Microcrack resistant structural composite tubes for space applications p 106 A87-41022 Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 Box truss antenna technology status p 87 N87-24503  GRAVITATION Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573  GRAVITATIONAL EFFECTS Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222 Dynamic and thermal effects in very large space structures p 25 N87-20347 Space station momentum management p 64 N87-20668 The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary [NASA-CR-178276] p 8 N87-21020 Equations of motion of a space station with emphasis on the effects of the gravity gradient [NASA-TM-86588] Verification of large beam-type space structures p 31 N87-22712 Phase 3 study of selected tether applications in space. Volume 1: Executive summary [NASA-CR-179185] p 131 N87-29585 GRAVITATIONAL FIELDS Optimal shuttle altitude changes using tethers [AD-A179205] p 129 N87-22756 GRAVITATIONAL PHYSIOLOGY A question of gravity p 1 A87-32116 GRAVITY GRADIENT SATELLITES Gravity-gradient stabilization of the Salyut 6-Soyuz	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station  [SAE PAPER 860928] p 163 A87-38718 Habitability issues for the Science Laboratory Module [SAE PAPER 860971] p 50 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 HABITATS  The undersea habitat as a space station analog: Evaluation of research and training potential [NASA-CR-180342] p 53 N87-27405 HANDLING EQUIPMENT  Remote handling facility and equipment used for space truss assembly [DE87-009121] p 103 N87-27408 HANGARS  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534 HANKEL FUNCTIONS  New time-domain identification technique for vibrating structures  HARDWARE Space Station p 146 A87-38722 p 106 A87-44741 MARDWARE Space Station galley design [SAE PAPER 860932] p 119 A87-38722 p 106 A87-44741 HARDWARE UTILIZATION LISTS  An evaluation of menu systems for Space Station interfaces p 111 A87-33040 HARMONIC EXCITATION  The effect of nonlinearities on flexible structures [AD-A181735] p 38 N87-27259 HARMONIC OSCILLATION  The effect of nonlinearities on flexible structures [AD-A181735] p 38 N87-27259 HAZARDS  Simulation of on-orbit satellite fragmentations p 140 N87-24515
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE An evolutionary approach to the development of a CELSS based air revitalization system [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS Proceedings of the NASA Workshop on Atomic Oxygen Effects low earth orbital environment [NASA-CR-181163] p 141 N87-26173  Dynamics of atom-surface interactions p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids Reactions of atomic oxygen (O(P-3)) with polybutacienes and related polymers p 109 N87-26185  Reactions of atomic oxygen (O(P-3)) with polybutacienes and related polymers p 109 N87-26197  Chemical interactions in Low Earth Orbit (LEO) p 109 N87-26197  Chemical interaction of p 109 N87-26200  Coundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams p 109 N87-26200  Potential surfaces for O atom-polymer reactions oxygen p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 109 N87-26206  GASEOUS ROCKET PROPELLANTS Hydrogen-oxygen thruster with no products of combustion in exhaust plume [AIAA PAPER 87-1775] p 91 A87-45196  GASES Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity p 46 A87-32457 A simulation model for the analysis of Space Station gas-phase trace contaminants p 52 A87-53979  GEOMAGNETIC MICROPULSATIONS The use of Pi2 pulsations as indicators of substorm effects at geostationary orbit p 142 N87-26942	Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-36600 Microcrack resistant structural composite tubes for space applications p 106 A87-41022 Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 Box truss antenna technology status p 87 N87-24503  GRAVITATION Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573  GRAVITATIONAL EFFECTS Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222 Dynamic and thermal effects in very large space structures p 25 N87-20347 Space station momentum management The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary [NASA-CR-178276] p 8 N87-21020 Equations of motion of a space station with emphasis on the effects of the gravity gradient [NASA-TM-86588] p 64 N87-21993 Verification of large beam-type space structures p 31 N87-22712 Phase 3 study of selected tether applications in space. Volume 1: Executive summary [NASA-CR-179185] p 131 N87-29585 GRAVITATIONAL FIELDS Optimal shuttle altitude changes using tethers [AD-A179205] GRAVITATIONAL PHYSIOLOGY A question of gravity p 1 A87-32801	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station  [SAE PAPER 860928] p 163 A87-38718 Habitability issues for the Science Laboratory Module [SAE PAPER 860971] p 50 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 HABITATS  The undersea habitat as a space station analog: Evaluation of research and training potential [NASA-CR-180342] p 53 N87-27405 HANDLING EQUIPMENT  Remote handling facility and equipment used for space truss assembly [DE87-009121] p 103 N87-27408 HANGARS  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534 HANKEL FUNCTIONS  New time-domain identification technique for vibrating structures p 58 A87-40869 HARDWARE  Space Station galley design [SAE PAPER 860932] p 119 A87-38722 Materials for space applications hARDWARE UTILIZATION LISTS  An evaluation of menu systems for Space Station interfaces p 111 A87-33040 HARMONIC EXCITATION  The effect of nonlinearities on flexible structures [AD-A181735] p 38 N87-27259 HARMONIC OSCILLATION  The effect of nonlinearities on flexible structures [AD-A181735] p 38 N87-27259 HAZARDS  Simulation of on-orbit satellite fragmentations p 140 N87-24515 HAZE  Space Station gas-grain simulation facility - Application to exobiology HEAD-UP DISPLAYS
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS  Proceedings of the NASA Workshop on Atomic Oxygen Effects low earth orbital environment [NASA-CR-181163] p 141 N87-26173  Dynamics of atomic oxygen interactions p 141 N87-26183  Laboratory studies of atomic oxygen reactions with solids  Reactions of atomic oxygen (O(P-3)) with polybutaclienes and related polymers p 109 N87-26197  Chemical interactions in Low Earth Orbit (LEO) p 109 N87-26197  Chemical interactions in Low Earth Orbit (LEO) p 109 N87-26201  Comments on the interaction of materials with atomic oxygen oxygen oxygen and nitrogen beams p 109 N87-26201  Comments on the interaction of materials with atomic oxygen GASEOUS ROCKET PROPELLANTS  Hydrogen-oxygen thruster with no products of combustion in exhaust plume [AIAA PAPER 87-1775] p 91 A87-45196  GASEOUS ROCKET PROPELLANTS  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity  A simulation model for the analysis of Space Station gas-phase trace contaminants  For the development of Space Station p 52 A87-53979  GEOLOGY  Solid Earth panel report Columbus program p 157 N87-20636  GEOMAGNETIC MICROPULSATIONS  The use of Pi2 pulsations as indicators of substorm effects at geostationary orbit p 142 N87-26942	Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-36600 Microcrack resistant structural composite tubes for space applications p 106 A87-41022 Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 Box truss antenna technology status p 87 N87-24503  GRAVITATION Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573 GRAVITATIONAL EFFECTS Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222 Dynamic and thermal effects in very large space structures p 25 N87-20347 Space station momentum management p 64 N87-20668 The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary [NASA-CR-178276] p 8 N87-21020 Equations of motion of a space station with emphasis on the effects of the gravity gradient [NASA-TM-86588] p 64 N87-21993 Verification of large beam-type space structures p 31 N87-22712 Phase 3 study of selected tether applications in space. Volume 1: Executive summary [NASA-CR-179185] p 131 N87-29585 GRAVITATIONAL FIELDS Optimal shuttle altitude changes using tethers [AD-A179205] p 129 N87-22756 GRAVITATIONAL PHYSIOLOGY A question of gravity p 1 A87-32116 GRAVITY GRADIENT SATELLITES Gravity-gradient stabilization of the Salyut 6-Soyuz orbital complex	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station  [SAE PAPER 860928] p 163 A87-38718 Habitability issues for the Science Laboratory Module [SAE PAPER 860971] p 50 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 HABITATS  The undersea habitat as a space station analog: Evaluation of research and training potential [NASA-CR-180342] p 53 N87-27405 HANDLING EQUIPMENT  Remote handling facility and equipment used for space truss assembly [DE87-009121] p 103 N87-27408 HANGARS  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534 HANKEL FUNCTIONS  New time-domain identification technique for vibrating structures p 58 A87-40869 HARDWARE  Space Station galley design [SAE PAPER 860932] p 119 A87-38722 p 106 A87-44741 HARDWARE UTILIZATION LISTS  An evaluation of menu systems for Space Station interfaces p 38 N87-27259 HARMONIC EXCITATION  The effect of nonlinearities on flexible structures [AD-A181735] p 38 N87-27259 HARMONIC OSCILLATION  The effect of nonlinearities on flexible structures [AD-A181735] p 38 N87-27259 HARADS  Simulation of on-orbit satellite fragmentations p 140 N87-24515 HAZARDS  Simulation of on-orbit satellite fragmentations p 140 N87-24515 HAZARDS  Simulation of display analysis for Space Station to exobiology p 127 A87-53002
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE  An evolutionary approach to the development of a CELSS based air revitalization system [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING  Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS  Proceedings of the NASA Workshop on Atomic Oxygen Effects low earth orbital environment [NASA-CR-181163] p 141 N87-26173  Dynamics of atom-surface interactions p 141 N87-26183  Laboratory studies of atomic oxygen reactions with solids  Reactions of atomic oxygen (O(P-3)) with polybutaclenes and related polymers p 109 N87-26185  Reactions of atomic oxygen (O(P-3)) with polybutaclenes and related polymers p 109 N87-26197  Chemical interactions in Low Earth Orbit (LEO)  p 109 N87-26207  Comments on the interaction of materials with atomic oxygen p 109 N87-26200  Potential surfaces for O atom-polymer reactions p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26201  GASEOUS ROCKET PROPELLANTS  Hydrogen-oxygen thruster with no products of combustion in exhaust plume [AIAA PAPER 87-1775] p 91 A87-45196  GASES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity  p 46 A87-32457  A simulation model for the analysis of Space Station gas-phase trace contaminants p 52 A87-53979  GEOLOGY  Solid Earth panel report Columbus program p 157 N87-20636  GEOMAGNETIC MICROPULSATIONS  The use of Pi2 pulsations as indicators of substorm effects at geostationary orbit p 142 N87-26942  GEOSYNCHROMOUS ORBITS  Geosynchronous earth orbit base propulsion - Electric propulsion options	Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-36600 Microcrack resistant structural composite tubes for space applications p 106 A87-41022 Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 Box truss antenna technology status p 87 N87-24503  GRAVITATION Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573  GRAVITATIONAL EFFECTS Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222 Dynamic and thermal effects in very large space structures p 25 N87-20347 Space station momentum management The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary [NASA-CR-178276] p 8 N87-21020 Equations of motion of a space station with emphasis on the effects of the gravity gradient [NASA-TM-86588] p 64 N87-21993 Verification of large beam-type space structures p 31 N87-22712 Phase 3 study of selected tether applications in space. Volume 1: Executive summary [NASA-CR-179185] p 131 N87-29585 GRAVITATIONAL FIELDS Optimal shuttle altitude changes using tethers [AD-A179205] GRAVITATIONAL PHYSIOLOGY A question of gravity p 1 A87-32801	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station  [SAE PAPER 860928] p 163 A87-38718 Habitation importance of the Science Laboratory Module p 50 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 M87-21585 The undersea habitat as a space station analog: Evaluation of research and training potential [NASA-CR-180342] p 53 N87-27405 M87-27405 M87-27408
[NASA-TM-88957] p 96 N87-24536  GAS EXCHANGE An evolutionary approach to the development of a CELSS based air revitalization system [SAE PAPER 860968] p 49 A87-38750  GAS TUNGSTEN ARC WELDING Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306  GAS-SOLID INTERACTIONS Proceedings of the NASA Workshop on Atomic Oxygen Effects — low earth orbital environment [NASA-CR-181163] p 141 N87-26173  Dynamics of atom-surface interactions p 141 N87-26183  Laboratory studies of atomic oxygen reactions with solids p 4 N87-26185  Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197  Chemical interactions in Low Earth Orbit (LEO) p 109 N87-26197  Chemical interactions in Low Earth Orbit (LEO) p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 109 N87-26201  Comments on the interaction of materials with atomic oxygen Oxygen Thuster with no products of combustion in exhaust plume [AIAA PAPER 87-1775] p 9 1 A87-45196  GASEOUS ROCKET PROPELLANTS Hydrogen-oxygen thruster with no products of combustion in exhaust plume [AIAA PAPER 87-1775] p 9 4 A87-32457 A simulation model for the analysis of Space Station gas-phase trace contaminants p 52 A87-53979  GEOLOGY Solid Earth panel report — Columbus program p 157 N87-20636  GEOMAGNETIC MICROPULSATIONS  The use of Pi2 pulsations as indicators of substorm effects at geostationary orbit p 142 N87-26942  GEOSYNCHRONOUS ORBITS Geosynchronous earth orbit base propulsion - Electric	Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279 Joint technology for graphite epoxy space structures p 20 A87-36600 Microcrack resistant structural composite tubes for space applications p 106 A87-41022 Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 Box truss antenna technology status  GRAVITATION Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573 GRAVITATIONAL EFFECTS Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222 Dynamic and thermal effects in very large space structures p 25 N87-20347 Space station momentum management p 64 N87-20668 The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary [NASA-CR-178276] p 8 N87-21020 Equations of motion of a space station with emphasis on the effects of the gravity gradient [NASA-TM-86588] p 64 N87-21993 Verification of large beam-type space structures p 31 N87-22712 Phase 3 study of selected tether applications in space. Volume 1: Executive summary [NASA-CR-179185] p 131 N87-29585 GRAVITATIONAL FIELDS Optimal shuttle altitude changes using tethers [AD-A179205] g N87-22756 GRAVITATIONAL PHYSIOLOGY A question of gravity p 1 A87-32116 GRAVITY GRADIENT SATELLITES Gravity-gradient stabilization of the Salyut 6-Soyuz orbital complex p 147 A87-32801 GRAZING INCIDENCE The Vanderbilt University neutral O-beam facility	ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002 Habitation module for the Space Station  [SAE PAPER 860928] p 163 A87-38718 Habitability issues for the Science Laboratory Module [SAE PAPER 860971] p 50 A87-38753 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585 HABITATS  The undersea habitat as a space station analog: Evaluation of research and training potential [NASA-CR-180342] p 53 N87-27405 HANDLING EQUIPMENT  Remote handling facility and equipment used for space truss assembly [DE87-009121] p 103 N87-27408 HANGARS  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534 HANKEL FUNCTIONS  New time-domain identification technique for vibrating structures p 58 A87-40869 HARDWARE  Space Station galley design [SAE PAPER 860932] p 119 A87-38722 p 106 A87-44741 HARDWARE UTILIZATION LISTS  An evaluation of menu systems for Space Station interfaces p 38 N87-27259 HARMONIC EXCITATION  The effect of nonlinearities on flexible structures [AD-A181735] p 38 N87-27259 HARMONIC OSCILLATION  The effect of nonlinearities on flexible structures [AD-A181735] p 38 N87-27259 HARADS  Simulation of on-orbit satellite fragmentations p 140 N87-24515 HAZARDS  Simulation of on-orbit satellite fragmentations p 140 N87-24515 HAZARDS  Simulation of display analysis for Space Station to exobiology p 127 A87-53002

# **HEAT BALANCE**

HEAT BALANCE	High power solar array technologies Columbus space	HUMAN WASTES
Evaluation of the infrared test method for the Olympus	station p 82 N87-28976	Development of a water recovery subsystem based on
thermal balance tests p 44 A87-46682	HISTORIES	Vapor Phase Catalytic Ammonia Removal (VPCAR) [SAE PAPER 860985] p 50 A87-38764
HEAT EXCHANGERS	Priorities and policy analysis - A response to Alex	An improved waste collection system for space flight
Development of a prototype two-phase thermal bus	Roland p 168 A87-41222	[SAE PAPER 861014] p 119 A87-38784
system for Space Station [AIAA PAPER 87-1628] p 44 A87-43126	Toward the year 2000: The near future of the American	HYDRAULIC EQUIPMENT
[AIAA PAPER 87-1628] p 44 A87-43126 Structural and preliminary thermal performance testing	civilian and military space programs [DE87-006467] p 171 N87-22697	Multi-axis vibration tests on spacecraft using hydraulic
of a pressure activated contact heat exchanger	HOLLOW CATHODES	exciters p 8 N87-20373
[AIAA PAPER 87-1540] p 44 A87-44843	Hollow cathode-based plasma contactor experiments for	HYDRAZINE ENGINES
HEAT PIPES	electrodynamic tether	Thermal design of a large spacecraft propulsion system
Determination of the cross-sectional temperature	[AIAA PAPER 87-0572] p 121 A87-32192	[AIAA PAPER 87-1863] p 44 A87-45258
distribution and boiling limitation of a heat pipe	Investigation of beam-plasma interactions	Propulsion recommendations for space station free
p 40 A87-32175	[NASA-CR-180579] p 129 N87-22508	flying platforms p 98 N87-26129
High capacity demonstration of honeycomb panel heat	Investigation of plasma contactors for use with orbiting	HYDROGEN
pipes [SAE PAPER 861833] p 41 A87-32666	wires	Hydrogen/oxygen economy for the space station
HEAT PUMPS	[NASA-CR-180922] p 129 N87-22509	p 98 N87-26130
A thermally-pumped heat transport system	Investigation of plasma contactors for use with orbiting	HYDROGEN ENGINES  Hydrogen-oxygen thruster with no products of
p 40 A87-32369	wires [NASA-CR-181422] p 131 N87-29591	combustion in exhaust plume
HEAT RADIATORS	[NASA-CR-181422] p 131 NB7-29591 HONEYCOMB STRUCTURES	[AIAA PAPER 87-1775] p 91 A87-45196
High capacity demonstration of honeycomb panel heat	High capacity demonstration of honeycomb panel heat	HYDROGEN OXYGEN ENGINES
pipes (SAF PAPER 861833) p 41 A87-32666	pipes	Space station propulsion system technology
[SAE PAPER 861833] p 41 A87-32666 Optimization of heat rejection subsystem for solar	[SAE PAPER 861833] p 41 A87-32666	[NASA-TM-100108] p 97 N87-25422
dynamic Brayton cycle power system	HOOP COLUMN ANTENNAS	A 25-LBF gaseous oxygen/gaseous hydrogen thruster
[SAE PAPER 860999] p 43 A87-38776	Robust controller synthesis for a large flexible space	for space station application p 98 N87-26132 Proven, long-life hydrogen/oxygen thrust chambers for
Liquid sheet radiator	antenna p 84 A87-32235	space station propulsion p 98 N87-26133
[AIAA PAPER 87-1525] p 43 A87-43048	Analysis of on-orbit thermal characteristics of the	HYDROGEN OXYGEN FUEL CELLS
Development of an emulation-simulation thermal control	15-meter hoop/column antenna	Advanced fuel cell concepts for future NASA missions
model for space station application [NASA-CR-180312] p 45 N87-26936	[NASA-TM-89137] p 45 N87-21021	p 99 N87-29930
[roter are re-	Controls-structures-electromagnetics interaction program p 69 N87-24502	HYGIENE
HEAT STORAGE Selection of high temperature thermal energy storage		Space Station personal hygiene study
materials for advanced solar dynamic space power	Hoop/column and tetrahedral truss electromagnetic	[SAE PAPER 860931] p 163 A87-38721
systems	Dynamic and thermal response finite element models	HYPERBARIC CHAMBERS  Hyperbaric oxygen therapy for decompression accidents
[NASA-TM-89886] p 78 N87-22174	of multi-body space structural configurations	- Potential applications to Space Station Operation
HEAT TRANSFER	[NASA-CR-178289] p 10 N87-24709	[SAE PAPER 860927] p 163 A87-38717
A two-dimensional numerical heat transfer model for a	A spline-based parameter and state estimation	HYPERSONIC VEHICLES
solar propulsion system p 74 A87-32306 A thermally-pumped heat transport system	technique for static models of elastic surfaces	Optimal heading change with minimum energy loss for
p 40 A87-32369	[NASA-CR-180449] p 11 N87-30107	a hypersonic gliding vehicle (AIAA PAPER 87-2568) p 136 A87-49618
Prototype thermal bus for manned Space Station	HOUSINGS	[,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
compartments	Preloadable vector sensitive latch	HYPERVELOCITY IMPACT Space station integrated wall design and penetration
[SAE PAPER 861825] p 41 A87-32668	[NASA-CASE-MSC-20910-1] p 161 N87-25582	damage control. Task 3: Theoretical analysis of penetration
Quality monitoring in two-phase heat transport systems	HUBBLE SPACE TELESCOPE	mechanics
for large spacecraft (SAF PAPER 860959) p 42 A87-38743	Hubble Space Telescope satellite servicing [SAE PAPER 861796] p 133 A87-32644	[NASA-CR-179166] p 39 N87-28582
[SAE PAPER 860959] p 42 A87-38743 Progress in theory, technology of space materials	,	
	Qualification of the faint object camera p 127 N87-20359	
science p 158 N87-27695	p 127 N87-20359	!
science p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application	p 127 N87-20359  Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728	ICE REPORTING
science p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702	p 127 N87-20359  Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728  A TREETOPS simulation of the Hubble Space	Ocean-ice panel report International Space Station
science p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft	p 127 N87-20359  Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728  A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction	Ocean-ice panel report International Space Station p 156 N87-20635
science p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004	p 127 N87-20359  Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728  A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735	Ocean-ice panel report International Space Station p 156 N87-20635
science p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004 HFAT TRANSMISSION	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735	Ocean-ice panel report International Space Station p 156 N87-20635 IMAGE ANALYSIS SOT: A rapid prototype using TAE windows
science p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004 <b>HEAT TRANSMISSION</b> Thermal test results of the two-phase thermal bus technology demonstration loop	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences	Ocean-ice panel report International Space Station p 156 N87-20635 IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161
science p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004 HFAT TRANSMISSION	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728  A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS  Conceptual planning for Space Station life sciences human research project	Ocean-ice panel report International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS
science p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004 HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125 HERMES MANNED SPACEPLANE	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751	Ocean-ice panel report International Space Station p 156 N87-20635 IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161
science p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004 HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125 HERMES MANNED SPACEPLANE The European space programme p 150 A87-37962	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING	Ocean-ice panel report International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING
science p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme p 150 A87-37962 Analysis and implementation of automation aspects in	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton,	Ocean-ice panel report International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing; Proceedings of the Meeting, Orlando,
science p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING	Ocean-ice panel report International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986
science p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1827] p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210] p 154 A87-48595	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2	Ocean-ice panel report International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIF-6441] p 125 A87-44176
science p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210] p 154 A87-48595  HIGH ALTITUDE	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728  A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS  Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING  Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001  The use of multidimensional scaling for facilities layout - An application to the design of the Space Station	Ocean-ice panel report International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Control of an autonomous spacecraft rendezvous and
science p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210] p 154 A87-48595  HIGH ALTITUDE Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001  The use of multidimensional scaling for facilities layout - An application to the design of the Space Station	Ocean-ice panel report International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIF-6441] p 125 A87-44176
science p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210] p 154 A87-48595  HIGH ALTITUDE Potential modulations on SCATHA (Spacecraft Charging	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001  The use of multidimensional scaling for facilities layout - An application to the design of the Space Station p 118 A87-33003 A comparison between space suited and unsuited reach	Ocean-ice panel report International Space Station p 156 N87-20635  IMAGE ANALYSIS  SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS  Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING  Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986  [SPIE-644] p 125 A87-44176  Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156
science p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210] p 154 A87-48595  HIGH ALTITUDE Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001  The use of multidimensional scaling for facilities layout - An application to the design of the Space Station p 118 A87-33003  A comparison between space suited and unsuited reach envelopes p 47 A87-33013	Ocean-ice panel report International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing: Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing
science p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1827] p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210] p 154 A87-48595  HIGH ALTITUDE Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft [AD-A176815] p 140 N87-21024  HIGH ENERGY INTERACTIONS High energy gamma ray astronomy	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001 The use of multidimensional scaling for facilities layout - An application to the design of the Space Station A comparison between space suited and unsuited reach envelopes p 162 A87-33013 Human performance in space p 162 A87-33013	Ocean-ice panel report International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986  [SPIE-644] p 125 A87-44176 Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Engineering graphics and image processing at Langley
science p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1827] p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210] p 154 A87-48595  HIGH ALTITUDE Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft [AD-A176815] p 140 N87-21024  HIGH ENERGY INTERACTIONS High energy gamma ray astronomy	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001  The use of multidimensional scaling for facilities layout - An application to the design of the Space Station p 118 A87-33003  A comparison between space suited and unsuited reach envelopes p 47 A87-33013  Human performance in space p 162 A87-33021  Human factors standards for space habitation	Ocean-ice panel report International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986  [SPIE-644] p 125 A87-44176 Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Engineering graphics and image processing at Langley Research Center p 10 N87-29129 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2
science p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210] p 154 A87-48595  HIGH ALTITUDE Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft [AD-A176815] p 140 N87-21024  HIGH ENERGY INTERACTIONS High energy gamma ray astronomy p 129 N87-24258	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001  The use of multidimensional scaling for facilities layout - An application to the design of the Space Station p 118 A87-33003  A comparison between space suited and unsuited reach envelopes partormance in space Human factors standards for space habitation p 162 A87-33021	Ocean-ice panel report International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Engineering graphics and image processing at Langley Research Center p 10 N87-29129 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144
science p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210] p 154 A87-48595 HIGH ALTITUDE Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft [AD-A176815] p 140 N87-21024  HIGH ENERGY INTERACTIONS High energy gamma ray astronomy p 129 N87-24258  HIGH FREQUENCIES Space Station 20-kHz power management and	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001  The use of multidimensional scaling for facilities layout - An application to the design of the Space Station p 118 A87-33003  A comparison between space suited and unsuited reach envelopes p 47 A87-33013  Human performance in space p 162 A87-33021  Human factors standards for space habitation p 162 A87-33022  Planning for unanticipated satellife servicing	Ocean-ice panel report International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Engineering graphics and image processing at Langley Research Center p 10 N87-29129 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2
science p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1827] p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210] p 154 A87-48595  HIGH ALTITUDE Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft [AD-A176815] p 140 N87-21024  HIGH ENERGY INTERACTIONS High energy gamma ray astronomy p 129 N87-24258  HIGH FREQUENCIES Space Station 20-kHz power management and distribution system	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001  The use of multidimensional scaling for facilities layout - An application to the design of the Space Station p 118 A87-33003  A comparison between space suited and unsuited reach envelopes p 47 A87-33012 Human performance in space habitation p 162 A87-33021 Planning for unanticipated sleipoperations p 118 A87-33048	Ocean-ice panel report — International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Engineering graphics and image processing at Langley Research Center p 10 N87-29129 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144
science p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210] p 154 A87-48595  HIGH ALTITUDE Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft [AD-A176815] p 140 N87-21024  HIGH ENERGY INTERACTIONS High energy gamma ray astronomy p 129 N87-24258  HIGH FREQUENCIES Space Station 20-kHz power management and distribution system 20 kHz Space Station power system	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001  The use of multidimensional scaling for facilities layout - An application to the design of the Space Station  A comparison between space suited and unsuited reach envelopes p 18 A87-33021  Human performance in space p 162 A87-33021  Human factors standards for space habitation p 162 A87-33022  Planning for unanticipated stellite servicing p 118 A87-33048  User interface design guidelines for expert troubleshooting systems for Space Station	Ocean-ice panel report International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Engineering graphics and image processing at Langley Research Center p 10 N87-29129 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144 Flight array processor p 116 N87-29148
p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221]  p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array  p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627]  p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme  p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210]  p 154 A87-48595  HIGH ALTITUDE Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft [AD-A176815]  p 140 N87-21024  HIGH ENERGY INTERACTIONS High energy gamma ray astronomy	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings, Volumes 1 & 2 p 162 A87-33001  The use of multidimensional scaling for facilities layout - An application to the design of the Space Station p 118 A87-33003  A comparison between space suited and unsuited reach envelopes p 47 A87-33013 Human performance in space p 162 A87-33021 Human factors standards for space habitation p 162 A87-33022 Planning for unanticipated steleoperations p 118 A87-33048 User interface design guidelines for expert troubleshooting systems — for Space Station p 6 A87-33050	Ocean-ice panel report International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Engineering graphics and image processing at Langley Research Center p 10 N87-29129 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144 Flight array processor p 116 N87-29148 Video image processing p 116 N87-29150  IMAGE RECONSTRUCTION Coded mask telescopes for X-ray astronomy
science p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1827] p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210] p 154 A87-48595  HIGH ALTITUDE Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft [AD-A176815] p 140 N87-21024  HIGH ENERGY INTERACTIONS High energy gamma ray astronomy p 129 N87-24258  HIGH FREQUENCIES Space Station 20-kHz power management and distribution system p 76 A87-36913 20 kHz Space Station power system p 76 A87-40378 Control considerations for high frequency, resonant,	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001  The use of multidimensional scaling for facilities layout - An application to the design of the Space Station p 118 A87-33003  A comparison between space suited and unsuited reach envelopes p 47 A87-33013  Human performance in space p 162 A87-33021  Human factors standards for space habitation p 162 A87-33022  Planning for unanticipated station p 118 A87-33048  User interface design guidelines for expert troubleshooting systems — for Space Station  P 6 A87-33050  Analysis of crew functions as an aid in Space Station	Ocean-ice panel report International Space Station p 156 N87-20635  IMAGE ANALYSIS  SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Engineering graphics and image processing at Langley Research Center p 10 N87-29129 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144 Flight array processor p 116 N87-29148 Video image processing p 116 N87-29150  IMAGE RECONSTRUCTION Coded mask telescopes for X-ray astronomy p 123 A87-37785
science p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210] p 154 A87-48595  HIGH ALTITUDE Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft [AD-A176815] p 140 N87-21024  HIGH ENERGY INTERACTIONS High energy gamma ray astronomy p 129 N87-24258  HIGH FREQUENCIES Space Station 20-kHz power management and distribution system p 75 A87-36913 20 kHz Space Station power system  Control considerations for high frequency, resonant, power processing equipment used in large systems	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001 The use of multidimensional scaling for facilities layout - An application to the design of the Space Station A comparison between space suited and unsuited reach envelopes Human performance in space p 162 A87-33013 Human performance in space habitation p 162 A87-33022 Planning for unanticipated satellite servicing teleoperations User interface design guidelines for expert troubleshooting systems — for Space Station p 6 A87-33050 Analysis of crew functions as an aid in Space Station interior layout	Ocean-ice panel report International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Engineering graphics and image processing at Langley Research Center p 10 N87-29129 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144 Flight array processor p 116 N87-29144 Video image processing p 116 N87-29150  IMAGE RECONSTRUCTION Coded mask telescopes for X-ray astronomy p 123 A87-37785
p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221]  p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array  p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627]  p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme  p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210]  p 154 A87-48595  HIGH ALTITUDE Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft [AD-A176815]  p 140 N87-21024  HIGH ENERGY INTERACTIONS High energy gamma ray astronomy	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001  The use of multidimensional scaling for facilities layout - An application to the design of the Space Station p 118 A87-33003  A comparison between space suited and unsuited reach envelopes p 162 A87-33021  Human performance in space p 162 A87-33021  Human factors standards for space habitation p 162 A87-33022  Planning for unanticipated stellite servicing teleoperations p 118 A87-33048  User interface design guidelines for expert troubleshooting systems — for Space Station interior layout  [SAE PAPER 860934] p 163 A87-38724	Ocean-ice panel report International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986  [SPIE-644] p 125 A87-44176 Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Engineering graphics and image processing at Langley Research Center p 10 N87-29129 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144 Video image processing p 116 N87-29148 Video image processing p 116 N87-29150  IMAGE RECONSTRUCTION Coded mask telescopes for X-ray astronomy p 123 A87-37785  IMAGE RESOLUTION Conceptual design of the High-Resolution Imaging
p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210] p 154 A87-48595 HIGH ALTITUDE Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft [AD-A176815] p 140 N87-21024  HIGH ENERGY INTERACTIONS High energy gamma ray astronomy p 129 N87-24258  HIGH FREQUENCIES Space Station 20-kHz power management and distribution system 20 kHz Space Station power system p 76 A87-40378 Control considerations for high frequency, resonant, power processing equipment used in large systems [NASA-TM-89926] p 68 N87-23690  HIGH TEMPERATURE	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001  The use of multidimensional scaling for facilities layout - An application to the design of the Space Station p 118 A87-33003  A comparison between space suited and unsuited reach envelopes p 47 A87-33013  Human performance in space p 162 A87-33021  Human factors standards for space habitation p 162 A87-33021  Planning for unanticipated stellete servicing teleoperations p 118 A87-33048 User interface design guidelines for expert troubleshooting systems — for Space Station interior layout [SAE PAPER 860934] p 163 A87-33550  A87-38724 Space suit reach and strength envelope	Ocean-ice panel report International Space Station p 156 N87-20635  IMAGE ANALYSIS  SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing: Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Engineering graphics and image processing at Langley Research Center p 10 N87-29129 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144 Flight array processor p 116 N87-29144 Video image processing p 116 N87-29150  IMAGE RECONSTRUCTION Coded mask telescopes for X-ray astronomy p 123 A87-37785  IMAGE RESOLUTION Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185
p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221]  p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array  p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627]  p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme  p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210]  p 154 A87-48595  HIGH ALTITUDE Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft [AD-A176815]  p 140 N87-21024  HIGH ENERGY INTERACTIONS High energy gamma ray astronomy	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001 The use of multidimensional scaling for facilities layout - An application to the design of the Space Station A comparison between space suited and unsuited reach envelopes p 18 A87-33021 Human performance in space p 162 A87-33021 Human performance in space p 162 A87-33022 Planning for unanticipated satellite servicing p 118 A87-33022 Planning for unanticipated satellite servicing p 118 A87-33048 User interface design guidelines for expert troubleshooting systems for Space Station	Ocean-ice panel report International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Engineering graphics and image processing at Langley Research Center p 10 N87-29129 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144 Flight array processor p 116 N87-29148 Video image processing p 116 N87-29150  IMAGE RECONSTRUCTION Coded mask telescopes for X-ray astronomy p 123 A87-37785  IMAGE RESOLUTION Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185  IMAGING SPECTROMETERS
p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210] p 154 A87-48595  HIGH ALTITUDE Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft [AD-A176815] p 140 N87-21024  HIGH ENERGY INTERACTIONS High energy gamma ray astronomy p 129 N87-24258  HIGH FREQUENCIES Space Station 20-kHz power management and distribution system 20 kHz Space Station power system p 76 A87-40378  Control considerations for high frequency, resonant, power processing equipment used in large systems [NASA-TM-89926] p 68 N87-23690  HIGH TEMPERATURE Selection of high temperature thermal energy storage materials for advanced solar dynamic space power	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001  The use of multidimensional scaling for facilities layout - An application to the design of the Space Station p 118 A87-33003  A comparison between space suited and unsuited reach envelopes p 47 A87-33013  Human performance in space p 162 A87-33021  Human factors standards for space habitation p 162 A87-33022  Planning for unanticipated stellite servicing teleoperations p 118 A87-33048 User interface design guidelines for expert troubleshooting systems — for Space Station interior layout [SAE PAPER 860934] p 163 A87-38724 Space suit reach and strength envelope considerations [SAE PAPER 860950] p 49 A87-38737  Human capabilities in space	Ocean-ice panel report — International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Engineering graphics and image processing at Langley Research Center p 10 N87-29129 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144 Flight array processor p 116 N87-29144 Flight array processing p 116 N87-29150  IMAGE RECONSTRUCTION Coded mask telescopes for X-ray astronomy p 123 A87-37785  IMAGE RESOLUTION Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185  IMAGING SPECTROMETERS Conceptual design of the High-Resolution Imaging
p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1827] p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210] p 154 A87-48595  HIGH ALTITUDE Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft [AD-A176815] p 140 N87-21024  HIGH ENERGY INTERACTIONS High energy gamma ray astronomy p 129 N87-24258  HIGH FREQUENCIES Space Station 20-kHz power management and distribution system p 76 A87-40378  Control considerations for high frequency, resonant, power processing equipment used in large systems [NASA-TM-89926] HIGH TEMPERATURE Selection of high temperature thermal energy storage materials for advanced solar dynamic space power	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001  The use of multidimensional scaling for facilities layout - An application to the design of the Space Station p 118 A87-33003  A comparison between space suited and unsuited reach envelopes p 162 A87-33021  Human performance in space p 162 A87-33013  Human performance in space p 162 A87-33022  Planning for unanticipated satellite servicing teleoperations user interface design guidelines for expert troubleshooting systems — for Space Station p 6 A87-33050  Analysis of crew functions as an aid in Space Station interior layout  [SAE PAPER 860934] p 163 A87-38724  Space suit reach and strength envelope considerations  [SAE PAPER 860950] p 49 A87-38737  Human capabilities in space [FAAS PAPER 86-114] p 165 A87-53099	Ocean-ice panel report International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Engineering graphics and image processing at Langley Research Center p 10 N87-29129 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144 Flight array processor p 116 N87-29148 Video image processing p 116 N87-29150  IMAGE RECONSTRUCTION Coded mask telescopes for X-ray astronomy p 123 A87-37785  IMAGE RESOLUTION Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185  IMAGING SPECTROMETERS Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185
science p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210] p 154 A87-48595  HIGH ALTITUDE Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft [AD-A176815] p 140 N87-21024  HIGH ENERGY INTERACTIONS High energy gamma ray astronomy p 129 N87-24258  HIGH FREQUENCIES Space Station 20-kHz power management and distribution system p 75 A87-36913 20 kHz Space Station power system  Control considerations for high frequency, resonant, power processing equipment used in large systems [NASA-TM-89926] p 68 N87-23690  HIGH TEMPERATURE Selection of high temperature thermal energy storage materials for advanced solar dynamic space power systems [NASA-TM-89886] p 78 N87-22174  HIGH TEMPERATURE PLASMAS	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001  The use of multidimensional scaling for facilities layout - An application to the design of the Space Station  P 118 A87-33003  A comparison between space suited and unsuited reach envelopes Human performance in space p 162 A87-33021  Human performance in space p 162 A87-33022  Planning for unanticipated stellite servicing p 118 A87-33048  User interface design guidelines for expert troubleshooting systems for Space Station  p 6 A87-33050  Analysis of crew functions as an aid in Space Station interior layout  [SAE PAPER 860934] p 163 A87-38724  Space suit reach and strength envelope considerations  [SAE PAPER 860950] p 49 A87-38737  Human capabilities in space  [AAS PAPER 86-114] p 165 A87-53089  Space station group activities habitability module study	Ocean-ice panel report International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing: Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Engineering graphics and image processing at Langley Research Center p 10 N87-29129 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144 Flight array processor p 116 N87-29144 Flight array processor p 116 N87-29148 Video image processing p 116 N87-29148 Video image processing p 116 N87-29150  IMAGE RECONSTRUCTION Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185  IMAGING SPECTROMETERS Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 Preliminary system concepts for MODIS - A moderate
p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221]  p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array  p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627]  p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210]  p 154 A87-48595  HIGH ALTITUDE Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft [AD-A176815]  p 140 N87-21024  HIGH ENERGY INTERACTIONS High energy gamma ray astronomy	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001  The use of multidimensional scaling for facilities layout - An application to the design of the Space Station p 118 A87-33003  A comparison between space suited and unsuited reach envelopes p 47 A87-33013  Human performance in space p 162 A87-33021  Human performance in space p 162 A87-33021  Human factors standards for space habitation p 162 A87-33022  Planning for unanticipated satellite servicing teleoperations p 118 A87-33048  User interface design guidelines for expert troubleshooting systems — for Space Station interior layout  [SAE PAPER 860934] p 163 A87-33050  Analysis of crew functions as an aid in Space Station interior layout  [SAE PAPER 860950] p 49 A87-38737  Human capabilities in space  [AAS PAPER 86-114] p 165 A87-53089  Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585	Ocean-ice panel report International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Engineering graphics and image processing at Langley Research Center p 10 N87-29129 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144 Flight array processor p 116 N87-29148 Video image processing p 116 N87-29150  IMAGE RECONSTRUCTION Coded mask telescopes for X-ray astronomy p 123 A87-37785  IMAGE RESOLUTION Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185  IMAGING SPECTROMETERS Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185
p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221]  p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array  p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1827]  p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme  p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210]  p 154 A87-48595  HIGH ALTITUDE Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft [AD-A176815]  p 140 N87-21024  HIGH ENERGY INTERACTIONS High energy gamma ray astronomy	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001 The use of multidimensional scaling for facilities layout - An application to the design of the Space Station A comparison between space suited and unsuited reach envelopes p 18 A87-33003 Human performance in space p 162 A87-33013 Human performance in space p 162 A87-33012 Planning for unanticipated attellite servicing p 118 A87-33022 Planning for unanticipated satellite servicing p 118 A87-33021 Conceptual Programment of Space Station P 6 A87-33050 Analysis of crew functions as an aid in Space Station interior layout [SAE PAPER 860934] p 163 A87-38724 Space suit reach and strength envelope considerations [SAE PAPER 860950] p 49 A87-38737 Human capabilities in space [AAS PAPER 86-114] p 165 A87-53089 Space station group activities habitability module study [NASA-CR-4010] Pravda commentary, photos of Mirr orbital station	Ocean-ice panel report — International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Engineering graphics and image processing at Langley Research Center p 10 N87-29129 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144 Flight array processor p 116 N87-29144 Video image processing p 116 N87-29150  IMAGE RECONSTRUCTION Coded mask telescopes for X-ray astronomy p 123 A87-37785  IMAGE RESOLUTION Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 Preliminary system concepts for MODIS - A moderate resolution imaging spectrometer for EOS p 126 A87-44185
p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210] p 154 A87-48595  HIGH ALTITUDE Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft [AD-A176815] p 140 N87-21024  HIGH ENERGY INTERACTIONS High energy gamma ray astronomy p 129 N87-24258  HIGH FREQUENCIES Space Station 20-kHz power management and distribution system p 75 A87-36913 20 kHz Space Station power system [NASA-TM-89926] p 68 N87-23690  HIGH TEMPERATURE Selection of high temperature thermal energy storage materials for advanced solar dynamic space power systems [NASA-TM-9886] p 78 N87-22174  HIGH TEMPERATURE PLASMAS Status of orbital astronomy projects	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001  The use of multidimensional scaling for facilities layout - An application to the design of the Space Station p 118 A87-33003  A comparison between space suited and unsuited reach envelopes p 162 A87-33021  Human performance in space p 162 A87-33021  Human factors standards for space habitation p 162 A87-33022  Planning for unanticipated stellite servicing p 118 A87-33048  User interface design guidelines for expert troubleshooting systems — for Space Station interior layout [SAE PAPER 860934] p 163 A87-38724  Space suit reach and strength envelope considerations [SAE PAPER 860950] p 49 A87-33073  Human capabilities in space [AAS PAPER 86-114] p 165 A87-3089  Space station group activities habitability module study [NASA-CR-4010] p 165 N87-27588	Ocean-ice panel report — International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Engineering graphics and image processing at Langley Research Center p 10 N87-29129 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144 Flight array processor p 116 N87-29144 Video image processing p 116 N87-29150  IMAGE RECONSTRUCTION Coded mask telescopes for X-ray astronomy p 123 A87-37785  IMAGE RESOLUTION Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185  IMAGING SPECTROMETERS Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 Preliminary system concepts for MODIS - A moderate resolution imaging spectrometer (HIRIS) for EOS p 126 A87-44186
p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221]  p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array  p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627]  p 44 A87-43125 HERMES MANNED SPACEPLANE The European space programme p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210]  p 154 A87-48595 HIGH ALTITUDE Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft [AD-A176815]  p 140 N87-21024 HIGH EMERGY INTERACTIONS High energy gamma ray astronomy	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001  The use of multidimensional scaling for facilities layout - An application to the design of the Space Station p 118 A87-33003  A comparison between space suited and unsuited reach envelopes p 47 A87-33013  Human performance in space p 162 A87-33021  Human factors standards for space habitation p 162 A87-33022  Planning for unanticipated steleoperations p 118 A87-33048  User interface design guidelines for expert troubleshooting systems — for Space Station interior layout [SAE PAPER 869934] p 163 A87-33050  Analysis of crew functions as an aid in Space Station interior layout [SAE PAPER 869950] p 49 A87-38771  Human capabilities in space [AAS PAPER 86950] p 49 A87-33089  Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585  HUMAN PERFORMANCE	Ocean-ice panel report International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Engineering graphics and image processing at Langley Research Center p 10 N87-29129 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144 Video image processing p 116 N87-29148 Video image processing p 116 N87-29150  IMAGE RECONSTRUCTION Coded mask telescopes for X-ray astronomy p 123 A87-37785  IMAGE RESOLUTION Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 Preliminary system concepts for MODIS - A moderate resolution imaging spectrometer for EOS  IMMUNOASSAY Expansion of space station diagnostic capability to include serological identification of viral and bacterial
Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221]	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001 The use of multidimensional scaling for facilities layout - An application to the design of the Space Station and Arrival Park 1 & A87-33003  A comparison between space suited and unsuited reach envelopes p 162 A87-33013 Human performance in space p 162 A87-33013 Human performance in space p 162 A87-33022 Planning for unanticipated satellite servicing p 118 A87-33022 Planning for unanticipated satellite servicing p 118 A87-33024 Space station gystems for Space Station p 6 A87-33050 Analysis of crew functions as an aid in Space Station interior layout [SAE PAPER 860934] p 163 A87-38724 Space suit reach and strength envelope considerations [SAE PAPER 860950] p 49 A87-38737 Human capabilities in space [AAS PAPER 86-114] p 165 A87-3089 Space station group activities habitability module study [NASA-CR-4010] Pravda commentary, photos of Mir orbital station p 158 N87-27688	Ocean-ice panel report — International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Engineering graphics and image processing at Langley Research Center p 10 N87-29129 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144 Flight array processor p 116 N87-29144 Video image processing p 116 N87-29150  IMAGE RECONSTRUCTION Coded mask telescopes for X-ray astronomy p 123 A87-37785  IMAGE RESOLUTION Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185  IMAGING SPECTROMETERS Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 Preliminary system concepts for MODIS - A moderate resolution imaging spectrometer (HIRIS) for EOS p 126 A87-44186
p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210] p 154 A87-48595  HIGH ALTITUDE Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft [AD-A176815] p 140 N87-21024  HIGH ENERGY INTERACTIONS High energy gamma ray astronomy p 129 N87-24258  HIGH FREQUENCIES Space Station 20-kHz power management and distribution system p 75 A87-36913 20 kHz Space Station power system [NASA-TM-89926] p 68 N87-23690  HIGH TEMPERATURE Selection of high temperature thermal energy storage materials for advanced solar dynamic space power systems [NASA-TM-89886] p 78 N87-22174  HIGH TEMPERATURE PLASMAS Status of orbital astronomy projects  p 128 N87-21973  HIGH VOLTAGES Coaxial tube array space transmission line characterization [NASA-TM-89864] p 96 N87-22003	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001  The use of multidimensional scaling for facilities layout - An application to the design of the Space Station p 118 A87-33003  A comparison between space suited and unsuited reach envelopes p 47 A87-33013  Human performance in space p 162 A87-33021  Human factors standards for space habitation p 162 A87-33022  Planning for unanticipated steleoperations p 118 A87-33048  User interface design guidelines for expert troubleshooting systems — for Space Station interior layout [SAE PAPER 869934] p 163 A87-33050  Analysis of crew functions as an aid in Space Station interior layout [SAE PAPER 869950] p 49 A87-38771  Human capabilities in space [AAS PAPER 86950] p 49 A87-33089  Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585  HUMAN PERFORMANCE	Ocean-ice panel report International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing: Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Engineering graphics and image processing at Langley Research Center p 10 N87-29129 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144 Flight array processor p 116 N87-29144 Video image processing p 116 N87-29148 Video image processing p 116 N87-29150  IMAGE RECONSTRUCTION Coded mask telescopes for X-ray astronomy p 123 A87-37785  IMAGE RESOLUTION Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 Preliminary system concepts for MODIS - A moderate resolution imaging spectrometer (FIRIS) for EOS p 126 A87-44186  IMMUNOASSAY Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections  IMPACT DAMAGE
science p. 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p. 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p. 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p. 44 A87-43125 HERMES MANNED SPACEPLANE The European space programme p. 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210] p. 154 A87-48595 HIGH ALTITUDE Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft [AD-A176815] p. 140 N87-21024 HIGH ENERGY INTERACTIONS High energy gamma ray astronomy p. 129 N87-24258  HIGH FREQUENCIES Space Station 20-kHz power management and distribution system 20 kHz Space Station power system P. 76 A87-40378 Control considerations for high frequency, resonant, power processing equipment used in large systems [NASA-TM-89926] p. 68 N87-23690 HIGH TEMPERATURE Selection of high temperature thermal energy storage materials for advanced solar dynamic space power systems [NASA-TM-89886] p. 78 N87-22174 HIGH VOLTAGES Coaxial tube array space transmission line characterization [NASA-TM-89864] p. 96 N87-22003 Computer modeling of high-voltage solar array	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001 The use of multidimensional scaling for facilities layout - An application to the design of the Space Station p 118 A87-33003 A comparison between space suited and unsuited reach envelopes Human performance in space p 162 A87-33021 Human performance in space p 162 A87-33022 Planning for unanticipated satellite servicing p 118 A87-33048 User interface design guidelines for expert troubleshooting systems for Space Station  p 6 A87-33050 Analysis of crew functions as an aid in Space Station interior layout [SAE PAPER 860934] p 163 A87-38724 Space suit reach and strength envelope considerations [SAE PAPER 860950] p 49 A87-38737 Human capabilities in space [AAS PAPER 86-114] p 165 A87-3008 Space station group activities habitability module study [NASA-CR-4010] p 165 N87-27585 HUMAN PERFORMANCE Human performance in space p 162 A87-33021 Workshop on Workload and Training, and Examination	Ocean-ice panel report — International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Engineering graphics and image processing at Langley Research Center p 10 N87-29129 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144 Flight array processor p 116 N87-29144 Flight array processor p 116 N87-29150  IMAGE RECONSTRUCTION Coded mask telescopes for X-ray astronomy p 123 A87-37785  IMAGE RESOLUTION Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 Preliminary system concepts for MODIS - A moderate resolution imaging spectrometer (HIRIS) for EOS p 126 A87-44186  IMMUNOASSAY Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703
p 158 N87-27695 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004  HEAT TRANSMISSION Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125  HERMES MANNED SPACEPLANE The European space programme p 150 A87-37962 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210] p 154 A87-48595  HIGH ALTITUDE Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft [AD-A176815] p 140 N87-21024  HIGH ENERGY INTERACTIONS High energy gamma ray astronomy p 129 N87-24258  HIGH FREQUENCIES Space Station 20-kHz power management and distribution system p 75 A87-36913 20 kHz Space Station power system [NASA-TM-89926] p 68 N87-23690  HIGH TEMPERATURE Selection of high temperature thermal energy storage materials for advanced solar dynamic space power systems [NASA-TM-89886] p 78 N87-22174  HIGH TEMPERATURE PLASMAS Status of orbital astronomy projects  p 128 N87-21973  HIGH VOLTAGES Coaxial tube array space transmission line characterization [NASA-TM-89864] p 96 N87-22003	Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735  HUMAN BEINGS Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  HUMAN FACTORS ENGINEERING Human Factors Society, Annual Meeting, 30th, Dayton, OH, Sept. 29-Oct. 3, 1986, Proceedings. Volumes 1 & 2 p 162 A87-33001  The use of multidimensional scaling for facilities layout - An application to the design of the Space Station p 118 A87-33003  A comparison between space suited and unsuited reach envelopes p 162 A87-33013  Human performance in space p 162 A87-33012  Planning for unanticipated p 162 A87-33022  Planning for unanticipated steleoperations p 118 A87-33048  User interface design guidelines for expert troubleshooting systems — for Space Station interior layout [SAE PAPER 860934] p 163 A87-33050  Analysis of crew functions as an aid in Space Station interior layout [SAE PAPER 860950] p 49 A87-38737  Human capabilities in space [AAS PAPER 860950] p 49 A87-38737  Human capabilities in space [AAS PAPER 860950] p 165 A87-3089  Space station group activities habitability module study [NASA-CR-4010] p 165 N87-27688  HUMAN PERFORMANCE  Human performance in space p 162 A87-33021  Workshop on Workload and Training, and Examination of their Interactions: Executive summany	Ocean-ice panel report International Space Station p 156 N87-20635  IMAGE ANALYSIS SOT: A rapid prototype using TAE windows p 114 N87-23161  IMAGE CORRELATORS Optical correlator use at Johnson Space Center p 59 A87-42655  IMAGE PROCESSING Remote sensing: Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Engineering graphics and image processing at Langley Research Center p 10 N87-29129 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144 Flight array processor p 116 N87-29144 Video image processing p 116 N87-29148 Video image processing p 116 N87-29150  IMAGE RECONSTRUCTION Coded mask telescopes for X-ray astronomy p 123 A87-37785  IMAGE RESOLUTION Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 Preliminary system concepts for MODIS - A moderate resolution imaging spectrometer (FIRIS) for EOS p 126 A87-44186  IMMUNOASSAY Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections  IMPACT DAMAGE

Space station integrated wall design and penetration damage control. Task 3: Theoretical analysis of penetration	INFRARED INSTRUMENTS Infrared test technique validation on the Olympus	INTERNATIONAL LAW  The station is raising lots of questions about space
mechanics	satellite	law p 167 A87-34597
[NASA-CR-179166] p 39 N87-28582 Space station integrated wall design and penetration	[SAE PAPER 860939] p 150 A87-38728 INFRARED RADIATION	Space stations and the law: Selected legal issues
damage control. Task 4: Impact detection/location	Evaluation of the infrared test method for the Olympus	[PB87-118220] p 171 N87-21754 INTERNATIONAL RELATIONS
system	thermal balance tests p 44 A87-46682	Cooperation between Europe and the United States in
[NASA-CR-179167] p 4 N87-28583 Micrometeorite impact on solar panels ESA	INFRARED SPACE OBSERVATORY (ISO) Infra-red astronomy after IRAS p 127 A87-54197	space (The Fulbright 40th Anniversary Lecture)
telecommunication satellites p 82 N87-28981	INFRARED TELESCOPES	p 170 A87-53924 INTERORBITAL TRAJECTORIES
IMPACT TESTS	Configuration tradeoffs for the space infrared telescope facility pointing control system p 121 A87-32236	Optimal trajectories for aeroassisted, coplanar orbital
Space station integrated wall design and penetration damage control. Task 4: Impact detection/location	Infra-red astronomy after IRAS p 127 A87-54197	transfer p 54 A87-31681
system	INORGANIC COMPOUNDS	INTERPLANETARY FLIGHT A survey of tether applications to planetary exploration
[NASA-CR-179167] p 4 N87-28583 IMPEDANCE	Kinetics and mechanisms of some atomic oxygen reactions p 141 N87-26179	[AAS PAPER 86-206] p 123 A87-38568
The radiation impedance of an electrodynamic tether	INSULATION	Prospects for space science
with end connectors p 125 A87-42585	Radiation charging and breakdown of insulators p 143 N87-26954	[AAS PAPER 86-106] p 170 A87-53085 Technology projections and space systems
IN-FLIGHT MONITORING	INTEGRATED OPTICS	opportunities for the 2000-2030 time period
Optimal placement of excitations and sensors for verification of large dynamical systems	Information network architectures p 116 N87-29149	[AAS PAPER 86-109] p 2 A87-53086
[AIAA PAPER 87-0782] p 19 A87-33755	INTELSAT SATELLITES Analysis of Intelsat V flight data	INTERPLANETARY SPACE Radiation shielding requirements on long-duration space
INDEXES (DOCUMENTATION)	[AIAA PAPER 87-0784] p 16 A87-33679	missions
Technology for Large Space Systems. A bibliography with indexes (supplement 17)	INTERACTIVE CONTROL  Commit your works to the Lord, and your thoughts shall	[AD-A177512] p 140 N87-21991
[NASA-SP-7046(17)] p 39 N87-29576	be established (Prov. 16:3). Inter-stable control systems	INTERPLANETARY SPACECRAFT  Space Station options for constructing advanced solar
INDIAN SPACECRAFT	p 9 N87-22716	sails capable of multiple Mars missions
Design and fabrication of Stretched Rohini Satellite-1 solar array p 83 N87-29006	Flexible spacecraft simulator p 31 N87-22718 Structural/control interaction (payload pointing and	[AIAA PAPER 87-1902] p 91 A87-45287
INDIUM	micro-g) p 9 N87-22721	INVERTED CONVERTERS (DC TO AC)  20 kHz Space Station power system
Surface modification to minimise the electrostatic	Structural dynamics system model reduction	p 76 A87-40378
charging of Kapton in the space environment p 87 N87-26959	p 32 N87-22727 NASA/DOD Control/Structures Interaction Technology,	Status of series-resonant power conversion with high
NDIUM COMPOUNDS	1986	internal frequencies. Support in definition of space station power interface
An electrically conductive thermal control surface for	[NASA-CP-2447-PT-2] p 34 N87-24495	[ESA-CR(P)-2319] p 79 N87-24533
spacecraft encountering Low-Earth Orbit (LEO) atomic oxygen indium tin oxide-coated thermal blankets	Controls-structures-electromagnetics interaction program p 69 N87-24502	ION ENGINES
p 45 N87-26192	Control technology overview in CSI	A UK large diameter ion thruster for primary propulsion
NELASTIC SCATTERING  Dynamics of atom-surface interactions	p 69 N87-24507 INTERCOSMOS SATELLITES	[AIAA PAPER 87-1031] p 89 A87-38015
p 141 N87-26183	Contribution of the German Democratic Republic (East	lon thrusters advance p 93 A87-54196
NERTIAL NAVIGATION	Germany) to the 'Intercosmos' program of study of	ION IMPLANTATION Surface modification to minimise the electrostatic
The Softmounted Inertially Reacting Pointing System (SIRPNT)	materials in space aboard the orbiting station Salyut 6 p 147 A87-32814	charging of Kapton in the space environment
[AAS PAPER 86-007] p 56 A87-32732	INTERFACES	p 87 N87-26959
NERTIAL UPPER STAGE	Proof that timing requirements of the FDDI token ring	Ram ion scattering caused by Space Shuttle v x B
The design and analysis of passive damping for aerospace systems	protocol are satisfied fiber distributed data interface p 112 A87-42821	induced differential charging p 140 A87-51713
[AIAA PAPER 87-0891] p 58 A87-39644	New power processor interfaces MMS power module	IONOSPHERIC PROPAGATION
[AIAA PAPER 87-0891] p 58 A87-39644 NFECTIOUS DISEASES	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft	
[AIAA PAPER 87-0891] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to	New power processor interfaces MMS power module	IONOSPHERIC PROPAGATION  Design of a beacon receiving system for the Olympus
[AIAA PAPER 87-0891] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION  Demands imposed on a surface tension propellant tank	IONOSPHERIC PROPAGATION  Design of a beacon receiving system for the Olympus
[AIAA PAPER 87-0891] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703  NFLATABLE STRUCTURES	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION  Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer	IONOSPHERIC PROPAGATION  Design of a beacon receiving system for the Olympus satellite p 86 A87-50157
[AIAA PAPER 87-0891] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703  NFLATABLE STRUCTURES  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION  Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space  [DGLR PAPER 86-104] p 88 A87-36756	IONOSPHERIC PROPAGATION  Design of a beacon receiving system for the Olympus satellite  p 86 A87-50157  J  JAPANESE SPACE PROGRAM
[AIAA PAPER 87-0891] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703  NFLATABLE STRUCTURES  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534  NFORMATION FLOW	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION  Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space  [DGLR PAPER 86-104] p 88 A87-36756  INTERNATIONAL COOPERATION	IONOSPHERIC PROPAGATION  Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  J  JAPANESE SPACE PROGRAM  Japanese space program p 143 A87-32285 Space Station program in a long-range space
[AIAA PAPER 87-0891] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703  NFLATABLE STRUCTURES  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DGLR PAPER 86-104] INTERNATIONAL COOPERATION Geostationary platforms - An international perspective	IONOSPHERIC PROPAGATION Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  J JAPANESE SPACE PROGRAM Japanese space program p 143 A87-32285 Space Station program in a long-range space development scenario of Japan p 145 A87-32530
[AIAA PAPER 87-0891] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703  NFLATABLE STRUCTURES  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534  NFORMATION FLOW  Information network architectures p 116 N87-29149  NFORMATION MANAGEMENT  Technical and Management Information System	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DGLR PAPER 86-104] p 88 A87-36756  INTERNATIONAL COOPERATION Geostationary platforms - An international perspective p 121 A87-32288 Space Station - Overview of the European concept of	IONOSPHERIC PROPAGATION Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  J  JAPANESE SPACE PROGRAM Japanese space program p 143 A87-32285 Space Station program in a long-range space development scenario of Japan p 145 A87-32530 Development of exposed deck of Japanese experiment
[AIA PAPER 87-0891] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703  NFLATABLE STRUCTURES  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534  NFORMATION FLOW  Information network architectures p 116 N87-29149  NFORMATION MANAGEMENT  Technical and Management Information System (TMIS)	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DCLR PAPER 86-104] INTERNATIONAL COOPERATION Geostationary platforms - An international perspective p 121 A87-32288 Space Station - Overview of the European concept of Columbus programme status and content	IONOSPHERIC PROPAGATION Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  J JAPANESE SPACE PROGRAM Japanese space program p 143 A87-32285 Space Station program in a long-range space development scenario of Japan p 145 A87-32530 Development of exposed deck of Japanese experiment module p 145 A87-32532 Japanese experiment module data management and
[AIAÁ PAPER 87-0891] p 58 A87-39644 NFECTIOUS DISEASES Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703 NFLATABLE STRUCTURES An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534 NFORMATION FLOW Information network architectures p 116 N87-29149 NFORMATION MANAGEMENT Technical and Management Information System (TMIS) [AIAA PAPER 87-2217] p 114 A87-48600 NFORMATION SYSTEMS	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DGLR PAPER 86-104] INTERNATIONAL COOPERATION Geostationary platforms - An international perspective p 121 A87-32288 Space Station - Overview of the European concept of Columbus programme status and content p 145 A87-3258 Contribution of the German Democratic Republic (East	IONOSPHERIC PROPAGATION Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  J  JAPANESE SPACE PROGRAM Japanese space program Space Station program in a long-range space development scenario of Japan p 145 A87-32530 Development of exposed deck of Japanese experiment module Japanese experiment module data management and communication system p 147 A87-32542
[AIA PAPER 87-0891] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703  NFLATABLE STRUCTURES  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534  NFORMATION FLOW  Information network architectures p 116 N87-29149  NFORMATION MANAGEMENT  Technical and Management Information System (TMIS)  [AIAA PAPER 87-2217] p 114 A87-48600  NFORMATION SYSTEMS  Japanese space information system overview	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DGLR PAPER 86-104] p 88 A87-36756  INTERNATIONAL COOPERATION Geostationary platforms - An international perspective p 121 A87-32288 Space Station - Overview of the European concept of Columbus programme status and content p 145 A87-32528 Contribution of the German Democratiic Republic (East Germany) to the "Intercosmos" program of study of	IONOSPHERIC PROPAGATION Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  J JAPANESE SPACE PROGRAM Japanese space program p 143 A87-32285 Space Station program in a long-range space development scenario of Japan p 145 A87-32530 Development of exposed deck of Japanese experiment module p 145 A87-32532 Japanese experiment module data management and communication system p 147 A87-32542 Japanese Experiment Module (JEM) preliminary design status p 151 A87-41570
[AIAÁ PAPER 87-0891] p 58 A87-39644 NFECTIOUS DISEASES Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703 NFLATABLE STRUCTURES An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534 NFORMATION FLOW Information network architectures p 116 N87-29149 NFORMATION MANAGEMENT Technical and Management Information System (TMIS) [AIAA PAPER 87-2217] p 114 A87-48600 NFORMATION SYSTEMS	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DGLR PAPER 86-104] INTERNATIONAL COOPERATION Geostationary platforms - An international perspective p 121 A87-32288 Space Station - Overview of the European concept of Columbus programme status and content p 145 A87-3258 Contribution of the German Democratic Republic (East	IONOSPHERIC PROPAGATION Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  J  JAPANESE SPACE PROGRAM Japanese space program p 143 A87-32285 Space Station program in a long-range space development scenario of Japan p 145 A87-32530 Development of exposed deck of Japanese experiment module p 145 A87-32532 Japanese experiment module data management and communication system p 147 A87-32542 Japanese Experiment Module (JEM) preliminary design status Japan's space development programs for
[AIAA PAPER 87-2891] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703  NFLATABLE STRUCTURES  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534  NFORMATION FLOW  Information network architectures p 116 N87-29149  NFORMATION MANAGEMENT  Technical and Management Information System (TMIS)  [AIAA PAPER 87-2217] p 114 A87-48600  NFORMATION SYSTEMS  Japanese space information system overview  [AIAA PAPER 87-2191] p 153 A87-48579  Scientific customer needs - NASA user  [AIAA PAPER 87-2196] p 119 A87-48582	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DGLR PAPER 86-104] INTERNATIONAL COOPERATION Geostationary platforms - An international perspective p 121 A87-32288 Space Station - Overview of the European concept of Columbus programme status and content p 145 A87-32528 Contribution of the German Democratic Republic (East Germany) to the 'Intercosmos' program of study of materials in space aboard the orbiting station Salyut 6 p 147 A87-32814 International cooperation in space	IONOSPHERIC PROPAGATION Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  J JAPANESE SPACE PROGRAM Japanese space program p 143 A87-32285 Space Station program in a long-range space development scenario of Japanes experiment module p 145 A87-32532 Japanese experiment module data management and communication system p 147 A87-32542 Japanese Experiment Module (JEM) preliminary design status p 151 A87-41570
[AIAA PAPER 87-0891] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703  NFLATABLE STRUCTURES  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534  NFORMATION FLOW Information network architectures p 116 N87-29149  NFORMATION MANAGEMENT Technical and Management Information System (TMIS)  [AIAA PAPER 87-2217] p 114 A87-48600  NFORMATION SYSTEMS Japanese space information system overview  [AIAA PAPER 87-2191] p 153 A87-48579  Scientific customer needs - NASA user [AIAA PAPER 87-2196] p 119 A87-48582  Data management standards for space information	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DGLR PAPER 86-104] P 88 A87-36756  INTERNATIONAL COOPERATION Geostationary platforms - An international perspective p 121 A87-32288 Space Station - Overview of the European concept of Columbus programme status and content p 145 A87-32528 Contribution of the German Democratic Republic (East Germany) to the "Intercosmos" program of study of materials in space aboard the orbiting station Salyut 6 p 147 A87-32814 International cooperation in space	IONOSPHERIC PROPAGATION Design of a beacon receiving system for the Olympus satellite  J  JAPANESE SPACE PROGRAM Japanese space program Space Station program in a long-range space development scenario of Japan Development of exposed deck of Japanese experiment module Japanese experiment module data management and communication system p 147 A87-32532 Japanese Experiment Module (JEM) preliminary design status Japan's space development programs for communications - An overview Japanese space information system overview [AIAA PAPER 87-2191] p 153 A87-48579
[AIAA PAPER 87-0891] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703  NFLATABLE STRUCTURES  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534  NFORMATION FLOW  Information network architectures p 116 N87-29149  NFORMATION MANAGEMENT  Technical and Management Information System (TMIS)  [AIAA PAPER 87-2217] p 114 A87-48600  NFORMATION SYSTEMS  Japanese space information system overview  [AIAA PAPER 87-2196] p 153 A87-48579  Scientific customer needs - NASA user  [AIAA PAPER 87-2196] p 119 A87-48582  Data management standards for space information systems  [AIAA PAPER 87-2205] p 113 A87-48590	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DGLR PAPER 86-104] INTERNATIONAL COOPERATION Geostationary platforms - An international perspective p 121 A87-32288 Space Station - Overview of the European concept of Columbus programme status and content p 145 A87-32528 Contribution of the German Democratic Republic (East Germany) to the 'Intercosmos' program of study of materials in space aboard the orbiting station Salyut 6 p 147 A87-32814 International cooperation in space p 149 A87-34594 Flunking on Space Station cooperation? p 150 A87-37964	Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  Japanese space program p 143 A87-32285 Space Station program in a long-range space development scenario of Japan p 145 A87-32530 Development of exposed deck of Japanese experiment module p 145 A87-32532 Japanese experiment module data management and communication system p 147 A87-32542 Japanese Experiment Module (JEM) preliminary design status p 151 A87-41570 Japan's space development programs for communications - An overview p 152 A87-43156 Japanese space information system overview [AIAA PAPER 87-2191] Japanese customer needs for Space Station
[AIAA PAPER 87-0891] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703  NFLATABLE STRUCTURES  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534  NFORMATION FLOW Information network architectures p 116 N87-29149  NFORMATION MANAGEMENT Technical and Management Information System (TMIS)  [AIAA PAPER 87-2217] p 114 A87-48600  NFORMATION SYSTEMS Japanese space information system overview  [AIAA PAPER 87-2196] p 119 A87-48579  Scientific customer needs - NASA user [AIAA PAPER 87-2196] p 119 A87-48582  Data management standards for space information systems  [AIAA PAPER 87-2205] p 113 A87-48590  Integrated scheduling and resource management for	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DGLR PAPER 86-104] P 88 A87-36756  INTERNATIONAL COOPERATION Geostationary platforms - An international perspective p 121 A87-32288 Space Station - Overview of the European concept of Columbus programme status and content p 145 A87-32528 Contribution of the German Democratiic Republic (East Germany) to the "Intercosmos" program of study of materials in space aboard the orbiting station Salyut 6 p 147 A87-32814 International cooperation in space P 149 A87-34594 Flunking on Space Station cooperation?  P 150 A87-37964 The Space Station overview p 168 A87-41571	Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  J  JAPANESE SPACE PROGRAM  Japanese space program p 143 A87-32285 Space Station program in a long-range space development scenario of Japan p 145 A87-32530 Development of exposed deck of Japanese experiment module p 145 A87-32532 Japanese experiment module data management and communication system p 147 A87-32542 Japanese Experiment Module (JEM) preliminary design status p 151 A87-41570 Japanese Experiment Module (JEM) preliminary design p 151 A87-41570 Japanese space information system overview p 152 A87-43156 Japanese space information system overview [AIAA PAPER 87-2191] p 153 A87-48579 Japanese customer needs for Space Station [AIAA PAPER 87-2193] p 153 A87-48580  JAPANESE SPACECRAFT
[AIAA PAPER 87-0891] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703  NFLATABLE STRUCTURES  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534  NFORMATION FLOW Information network architectures p 116 N87-29149  NFORMATION MANAGEMENT  Technical and Management Information System (TMIS)  [AIAA PAPER 87-2217] p 114 A87-48600  NFORMATION SYSTEMS  Japanese space information system overview  [AIAA PAPER 87-2191] p 153 A87-48579  Scientific customer needs - NASA user  [AIAA PAPER 87-2196] p 119 A87-48582  Data management standards for space information systems  [AIAA PAPER 87-2205] p 113 A87-48590  Integrated scheduling and resource management for Space Station Information System	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DGLR PAPER 86-104] P 88 A87-36756  INTERNATIONAL COOPERATION Geostationary platforms - An international perspective p 121 A87-32288 Space Station - Overview of the European concept of Columbus programme status and content Columbus programme status and content Germany) to the "Intercosmos" program of study of materials in space aboard the orbiting station Salyut 6 p 147 A87-32814 International cooperation in space p 149 A87-34594 Flunking on Space Station cooperation? The Space Station overview p 188 A87-41571 Trends in space transportation p 188 A87-41572	Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  Japanese space program p 143 A87-32285 Space Station program in a long-range space development scenario of Japan p 145 A87-32530 Development of exposed deck of Japanese experiment module p 145 A87-32532 Japanese experiment module data management and communication system p 147 A87-32542 Japanese Experiment Module (JEM) preliminary design status p 151 A87-41570 Japan's space development programs for communications - An overview p 152 A87-43156 Japanese space information system overview [AIAA PAPER 87-2191] p 153 A87-48579 Japanese customer needs for Space Station [AIAA PAPER 87-2193] p 153 A87-48580  JAPANESE SPACECRAFT Status of Japanese Experiment Module design
[AIAA PAPER 87-291] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703  NFLATABLE STRUCTURES  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534  NFORMATION FLOW  Information network architectures p 116 N87-29149  NFORMATION MANAGEMENT  Technical and Management Information System (TMIS)  [AIAA PAPER 87-2217] p 114 A87-48600  NFORMATION SYSTEMS  Japanese space information system overview  [AIAA PAPER 87-2196] p 153 A87-48579  Scientific customer needs - NASA user  [AIAA PAPER 87-2216] p 119 A87-48582  Data management standards for space information systems  [AIAA PAPER 87-2205] p 113 A87-48590  Integrated scheduling and resource management — for Space Station Information System  [AIAA PAPER 87-2213] p 119 A87-48597  Technical and Management Information System  [AIAA PAPER 87-2213] p 119 A87-48597  Technical and Management Information System	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DGLR PAPER 86-104] P 88 A87-36756  INTERNATIONAL COOPERATION Geostationary platforms - An international perspective p 121 A87-32288 Space Station - Overview of the European concept of Columbus programme status and content p 145 A87-32528 Contribution of the German Democratiic Republic (East Germany) to the "Intercosmos" program of study of materials in space aboard the orbiting station Salyut 6 p 147 A87-32814 International cooperation in space P 149 A87-34594 Flunking on Space Station cooperation?  P 150 A87-37964 The Space Station overview p 168 A87-41571	Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  J  JAPANESE SPACE PROGRAM  Japanese space program p 143 A87-32285 Space Station program in a long-range space development scenario of Japan p 145 A87-32530 Development of exposed deck of Japanese experiment module p 145 A87-32532 Japanese experiment module data management and communication system p 147 A87-32542 Japanese Experiment Module (JEM) preliminary design status p 151 A87-41570 Japanese Experiment Module (JEM) preliminary design p 151 A87-41570 Japanese space information system overview p 152 A87-43156 Japanese space information system overview [AIAA PAPER 87-2191] p 153 A87-48579 Japanese customer needs for Space Station [AIAA PAPER 87-2193] p 153 A87-48580  JAPANESE SPACECRAFT
[AIAA PAPER 87-0891] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703  NFLATABLE STRUCTURES  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534  NFORMATION FLOW Information network architectures p 116 N87-29149  NFORMATION MANAGEMENT  Technical and Management Information System (TMIS)  [AIAA PAPER 87-2217] p 114 A87-48600  NFORMATION SYSTEMS  Japanese space information system overview  [AIAA PAPER 87-2196] p 119 A87-48579  Scientific customer needs - NASA user  [AIAA PAPER 87-2196] p 119 A87-48590  Integrated scheduling and resource management for Space Station Information System  [AIAA PAPER 87-2213] p 119 A87-48597  Technical and Management Information System  [TMIS)	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DGLR PAPER 86-104] P 88 A87-36756  INTERNATIONAL COOPERATION Geostationary platforms - An international perspective p 121 A87-32288 Space Station - Overview of the European concept of Columbus programme status and content Contribution of the German Democratic Republic (East Germany) to the "Intercosmos" program of study of materials in space aboard the orbiting station Salyut 6 p 147 A87-32814 International cooperation in space p 149 A87-34594 Flunking on Space Station cooperation? p 150 A87-37964 The Space Station overview p 188 A87-41571 Trends in space transportation p 168 A87-46332 Operational instruments on the Space Station-Polar	Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  Japanese space program p 143 A87-32285 Space Station program in a long-range space development scenario of Japan p 145 A87-32530 Development of exposed deck of Japanese experiment module p 145 A87-32532 Japanese experiment module data management and communication system p 147 A87-32542 Japanese Experiment Module (JEM) preliminary design status p 151 A87-41570 Japan's space development programs for communications - An overview p 152 A87-43156 Japanese space information system overview [AIAA PAPER 87-2191] p 153 A87-48579 Japanese customer needs for Space Station [AIAA PAPER 87-2193] p 153 A87-48580  JAPANESE SPACECRAFT Status of Japanese Experiment Module design p 145 A87-32531 Japanese data relay satellite system [AIAA PAPER 87-2199] p 154 A87-48585
[AIAA PAPER 87-291] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703  NFLATABLE STRUCTURES  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534  NFORMATION FLOW  Information network architectures p 116 N87-29149  NFORMATION MANAGEMENT  Technical and Management Information System (TMIS)  [AIAA PAPER 87-2217] p 114 A87-48600  NFORMATION SYSTEMS  Japanese space information system overview  [AIAA PAPER 87-2196] p 153 A87-48579  Scientific customer needs - NASA user  [AIAA PAPER 87-2216] p 119 A87-48582  Data management standards for space information systems  [AIAA PAPER 87-2205] p 113 A87-48590  Integrated scheduling and resource management — for Space Station Information System  [AIAA PAPER 87-2213] p 119 A87-48597  Technical and Management Information System  [AIAA PAPER 87-2213] p 119 A87-48597  Technical and Management Information System	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DGLR PAPER 86-104] INTERNATIONAL COOPERATION Geostationary platforms - An international perspective p 121 A87-32288 Space Station - Overview of the European concept of Columbus programme status and content p 145 A87-32286 Contribution of the German Democratic Republic (East Germany) to the "Intercosmos" program of study of materials in space aboard the orbiting station Salyut 6 p 147 A87-32814 International cooperation in space p 149 A87-34594 Flunking on Space Station cooperation? p 150 A87-34964 The Space Station overview p 168 A87-41571 Trends in space transportation p 168 A87-41572 Man's role in space exploration and exploitation p 169 A87-46332 Operational instruments on the Space Station-Polar Platforms - Contributions by NOAA and the international	Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  JAPANESE SPACE PROGRAM  Japanese space program p 143 A87-32285 Space Station program in a long-range space development scenario of Japan p 145 A87-32530 Development of exposed deck of Japanese experiment module p 145 A87-32532 Japanese experiment module data management and communication system p 151 A87-41570 Japan's space development programs for communications - An overview p 152 A87-43156 Japanese space information system overview [AIAA PAPER 87-2191] p 153 A87-48580  JAPANESE SPACECRAFT Status of Japanese Experiment Module design p 145 A87-32531 Japanese data relay satellite system [AIAA PAPER 87-2199] p 154 A87-32531 Japanese data relay satellite system [AIAA PAPER 87-2199] p 154 A87-48585  JET MIXING FLOW
[AIAA PAPER 87-0891] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703  NFLATABLE STRUCTURES  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534  NFORMATION FLOW Information network architectures p 116 N87-29149  NFORMATION MANAGEMENT Technical and Management Information System (TMIS)  [AIAA PAPER 87-2217] p 114 A87-48600  NFORMATION SYSTEMS  Japanese space information system overview  [AIAA PAPER 87-2196] p 119 A87-48579  Scientific customer needs - NASA user [AIAA PAPER 87-2196] p 119 A87-48582  Data management standards for space information systems  [AIAA PAPER 87-2205] p 113 A87-48590  Integrated scheduling and resource management for Space Station Information System  [AIAA PAPER 87-2213] p 119 A87-48597  Technical and Management Information System (TMIS)  [AIAA PAPER 87-2217] p 114 A87-48600  EVOLUTION of data management systems from Spacelab to Columbus	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DGLR PAPER 86-104] p 88 A87-36756  INTERNATIONAL COOPERATION Geostationary platforms - An international perspective p 121 A87-32288 Space Station - Overview of the European concept of Columbus programme status and content p 145 A87-32528 Contribution of the German Democratic Republic (East Germany) to the 'Intercosmos' program of study of materials in space aboard the orbiting station Salyut 6 p 147 A87-32814 International cooperation in space p 149 A87-32814 Flunking on Space Station cooperation? p 150 A87-37964 The Space Station overview p 188 A87-41571 Trends in space transportation p 168 A87-41572 Man's role in space exploration and exploitation p 169 A87-46332 Operational instruments on the Space Station-Polar Platforms - Contributions by NOAA and the international community p 127 A87-53149	Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  Japanese space program p 143 A87-32285 Space Station program in a long-range space development scenario of Japan p 145 A87-32530 Development of exposed deck of Japanese experiment module p 145 A87-32532 Japanese experiment module data management and communication system p 147 A87-32542 Japanese Experiment Module (JEM) preliminary design status p 151 A87-41570 Japanese pace information system p 152 A87-43156 Japanese space information system overview [AIAA PAPER 87-2191] p 153 A87-48579 Japanese customer needs for Space Station [AIAA PAPER 87-2193] p 153 A87-48580 JAPANESE SPACECRAFT Status of Japanese Experiment Module design p 145 A87-32531 Japanese data relay satellite system [AIAA PAPER 87-2199] p 154 A87-32531 Japanese data relay satellite system [AIAA PAPER 87-2199] p 154 A87-48585  JET MIXING FLOW Mixing-induced ullage condensation and fluid destratification
[AIAA PAPER 87-0891] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703  NFLATABLE STRUCTURES  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534  NFORMATION FLOW  Information network architectures p 116 N87-29149  NFORMATION MANAGEMENT  Technical and Management Information System (TMIS)  [AIAA PAPER 87-2217] p 114 A87-48600  NFORMATION SYSTEMS  Japanese space information system overview  [AIAA PAPER 87-2191] p 153 A87-48579  Scientific customer needs - NASA user  [AIAA PAPER 87-2196] p 119 A87-48582  Data management standards for space information systems  [AIAA PAPER 87-2205] p 113 A87-48590  Integrated scheduling and resource management for Space Station Information System  [AIAA PAPER 87-2213] p 119 A87-48597  Technical and Management Information System  [AIAA PAPER 87-2213] p 119 A87-48597  Technical and Management Information System  [AIAA PAPER 87-2217] p 114 A87-48600  EVOlution of data management systems from Spacelab to Columbus  [AIAA PAPER 87-2227] p 154 A87-48605	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DGLR PAPER 86-104] P 88 A87-36756  INTERNATIONAL COOPERATION Geostationary platforms - An international perspective p 121 A87-32288 Space Station - Overview of the European concept of Columbus programme status and content  Contribution of the German Democratic Republic (East Germany) to the "Intercosmos" program of study of materials in space aboard the orbiting station Salyut 6 p 147 A87-32814  International cooperation in space Flunking on Space Station cooperation?  The Space Station overview p 188 A87-41571 Trends in space transportation p 168 A87-41571 Trends in space exploration and exploitation p 169 A87-46332 Operational instruments on the Space Station-Polar Platforms - Contributions by NOAA and the international community The GDR and the Soviet space program - The optical instrument sector of the GDR contributions	Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  JAPANESE SPACE PROGRAM  Japanese space program p 143 A87-32285 Space Station program in a long-range space development scenario of Japan p 145 A87-32530 Development of exposed deck of Japanese experiment module p 145 A87-32532 Japanese experiment module data management and communication system p 151 A87-41570 Japan's space development programs for communications - An overview p 152 A87-43156 Japanese space information system overview [AIAA PAPER 87-2191] p 153 A87-48580 JAPANESE SPACECRAFT Status of Japanese Experiment Module design p 145 A87-32531 Japanese data relay satellite system [AIAA PAPER 87-2199] p 154 A87-48585  JET MIXING FLOW  Mixing-induced ullage condensation and fluid destratification [AIAA PAPER 87-2018] p 92 A87-45357
[AIAA PAPER 87-0891] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703  NFLATABLE STRUCTURES  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534  NFORMATION FLOW  Information network architectures p 116 N87-29149  NFORMATION MANAGEMENT  Technical and Management Information System (TMIS)  [AIAA PAPER 87-2217] p 114 A87-48600  NFORMATION SYSTEMS  Japanese space information system overview  [AIAA PAPER 87-2196] p 119 A87-48579  Scientific customer needs - NASA user  [AIAA PAPER 87-2196] p 119 A87-48590  Integrated scheduling and resource management — for Space Station Information System  [AIAA PAPER 87-2213] p 119 A87-48597  Technical and Management Information System  [AIAA PAPER 87-2217] p 119 A87-48597  Technical and Management systems from Spacelab to Columbus  [AIAA PAPER 87-2217] p 114 A87-48600  Evolution of data management systems from Spacelab to Columbus  [AIAA PAPER 87-2227] p 154 A87-48605  Space Station Information System integrated communications concept	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DGLR PAPER 86-104] INTERNATIONAL COOPERATION Geostationary platforms - An international perspective p 121 A87-32288 Space Station - Overview of the European concept of Columbus programme status and content p 145 A87-3258 Contribution of the German Democratic Republic (East Germany) to the 'Intercosmos' program of study of materials in space aboard the orbiting station Salyut 6 p 147 A87-32814 International cooperation in space p 149 A87-34594 Flunking on Space Station cooperation? The Space Station overview p 180 A87-41571 Trends in space transportation p 168 A87-41571 Trends in space exploration and exploitation p 169 A87-46332 Operational instruments on the Space Station-Polar Platforms - Contributions by NOAA and the international community The GDR and the Soviet space program - The optical instrument sector of the GDR contributions	Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  Japanese space program p 143 A87-32285 Space Station program in a long-range space development scenario of Japan p 145 A87-32530 Development of exposed deck of Japanese experiment module p 145 A87-32532 Japanese experiment module data management and communication system p 147 A87-32542 Japanese Experiment Module (JEM) preliminary design status p 151 A87-41570 Japanese pace information system p 152 A87-43156 Japanese space information system overview [AIAA PAPER 87-2191] p 153 A87-48579 Japanese customer needs for Space Station [AIAA PAPER 87-2193] p 153 A87-48580 JAPANESE SPACECRAFT Status of Japanese Experiment Module design p 145 A87-32531 Japanese data relay satellite system [AIAA PAPER 87-2199] p 154 A87-32531 Japanese data relay satellite system [AIAA PAPER 87-2199] p 154 A87-48585  JET MIXING FLOW Mixing-induced ullage condensation and fluid destratification
[AIAÁ PAPER 87-0891] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703  NFLATABLE STRUCTURES  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534  NFORMATION FLOW  Information network architectures p 116 N87-29149  NFORMATION MANAGEMENT  Technical and Management Information System (TMIS)  [AIAA PAPER 87-2217] p 114 A87-48600  NFORMATION SYSTEMS  Japanese space information system overview  [AIAA PAPER 87-2191] p 153 A87-48579  Scientific customer needs - NASA user  [AIAA PAPER 87-2196] p 119 A87-48582  Data management standards for space information systems  [AIAA PAPER 87-2205] p 113 A87-48590  Integrated scheduling and resource management for Space Station Information System  [AIAA PAPER 87-2213] p 119 A87-48597  Technical and Management Information System (TMIS)  [AIAA PAPER 87-2217] p 114 A87-48600  EVOLution of data management systems from Spacelab to Columbus  [AIAA PAPER 87-2227] p 154 A87-48605  Space Station Information System integrated communications concept  [AIAA PAPER 87-2228] p 114 A87-48606	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DGLR PAPER 86-104] INTERNATIONAL COOPERATION Geostationary platforms - An international perspective p 121 A87-32288 Space Station - Overview of the European concept of Columbus programme status and content p 145 A87-32528 Contribution of the German Democratic Republic (East Germany) to the "Intercosmos" program of study of materials in space aboard the orbiting station Salyut 6 p 147 A87-32814 International cooperation in space p 149 A87-34594 Flunking on Space Station cooperation? p 150 A87-37964 The Space Station overview p 168 A87-41571 Trends in space transportation p 168 A87-41572 Man's role in space exploration and exploitation p 169 A87-46332 Operational instruments on the Space Station-Polar Platforms - Contributions by NOAA and the international community p 127 A87-53149 The GDR and the Soviet space program - The optical instrument sector of the GDR contributions p 155 A87-53559 Cooperation between Europe and the United States in	Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  JAPANESE SPACE PROGRAM  Japanese space program p 143 A87-32285 Space Station program in a long-range space development scenario of Japan p 145 A87-32530 Development of exposed deck of Japanese experiment module p 145 A87-32532 Japanese experiment module data management and communication system p 147 A87-32542 Japanese Experiment Module (JEM) preliminary design status p 151 A87-41570 Japan's space development programs for communications - An overview p 152 A87-43156 Japanese space information system overview [AIAA PAPER 87-2191] p 153 A87-48579 Japanese customer needs for Space Station [AIAA PAPER 87-2193] p 153 A87-48580  JAPANESE SPACECRAFT Status of Japanese Experiment Module design p 145 A87-32531 Japanese data relay satellite system [AIAA PAPER 87-2199] p 154 A87-48585  JET MIXING FLOW Mixing-induced ullage condensation and fluid destratification [AIAA PAPER 87-2018] p 92 A87-45357 Temperature fields due to jet induced mixing in a typical OTV tank [AIAA PAPER 87-2017] p 93 A87-52247
[AIAA PAPER 87-0891] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703  NFLATABLE STRUCTURES  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534  NFORMATION FLOW  Information network architectures p 116 N87-29149  NFORMATION MANAGEMENT  Technical and Management Information System (TMIS)  [AIAA PAPER 87-2217] p 114 A87-48600  NFORMATION SYSTEMS  Japanese space information system overview  [AIAA PAPER 87-2196] p 119 A87-48579  Scientific customer needs - NASA user  [AIAA PAPER 87-2196] p 119 A87-48590  Integrated scheduling and resource management — for Space Station Information System  [AIAA PAPER 87-2213] p 119 A87-48597  Technical and Management Information System  [AIAA PAPER 87-2217] p 119 A87-48597  Technical and Management systems from Spacelab to Columbus  [AIAA PAPER 87-2217] p 114 A87-48600  Evolution of data management systems from Spacelab to Columbus  [AIAA PAPER 87-2227] p 154 A87-48605  Space Station Information System integrated communications concept	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DGLR PAPER 86-104] INTERNATIONAL COOPERATION Geostationary platforms - An international perspective p 121 A87-32288 Space Station - Overview of the European concept of Columbus programme status and content p 145 A87-3258 Contribution of the German Democratic Republic (East Germany) to the 'Intercosmos' program of study of materials in space aboard the orbiting station Salyut 6 p 147 A87-32814 International cooperation in space p 149 A87-34594 Flunking on Space Station cooperation? p 150 A87-37964 The Space Station overview p 168 A87-41571 Trends in space transportation p 168 A87-41571 Trends in space exploration and exploitation p 169 A87-45322 Operational instruments on the Space Station-Polar Platforms - Contributions by NOAA and the international community p 127 A87-53149 The GDR and the Soviet space program - The optical instrument sector of the GDR contributions p 155 A87-53559 Cooperation between Europe and the United States in space (The Fulbright 40th Anniversary Lecture)	Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  Japanese Space Program Japanese space program a long-range space development scenario of Japan p 145 A87-32530 Development scenario of Japan p 145 A87-32530 Development of exposed deck of Japanese experiment module p 145 A87-32532 Japanese experiment module data management and communication system p 147 A87-32532 Japanese Experiment Module (JEM) preliminary design status Japan's space development communications - An overview p 152 A87-41570 Japan's space development communications - An overview p 152 A87-43156 Japanese space information system overview [AIAA PAPER 87-2191] p 153 A87-48579 Japanese customer needs for Space Station [AIAA PAPER 87-2193] p 153 A87-48580  JAPANESE SPACECRAFT Status of Japanese Experiment Module design p 145 A87-32531  Japanese data relay satellite system [AIAA PAPER 87-2199] p 154 A87-48585  JET MIXING FLOW Mixing-induced ullage condensation and fluid destratification [AIAA PAPER 87-2018] p 92 A87-45357  Temperature fields due to jet induced mixing in a typical OTV tank [AIAA PAPER 87-2017] p 93 A87-52247  JOINTS (JUNCTIONS)
[AIAA PAPER 87-293] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703  NFLATABLE STRUCTURES  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534  NFORMATION FLOW  Information network architectures p 116 N87-29149  NFORMATION MANAGEMENT  Technical and Management Information System (TMIS)  [AIAA PAPER 87-2217] p 114 A87-48600  NFORMATION SYSTEMS  Japanese space information system overview  [AIAA PAPER 87-2191] p 153 A87-48579  Scientific customer needs - NASA user  [AIAA PAPER 87-2196] p 119 A87-48582  Data management standards for space information systems  [AIAA PAPER 87-2205] p 113 A87-48590  Integrated scheduling and resource management for Space Station Information Systems  [AIAA PAPER 87-2213] p 119 A87-48597  Technical and Management Information System (TMIS)  [AIAA PAPER 87-2217] p 114 A87-48600  Evolution of data management systems from Spacelab to Columbus  [AIAA PAPER 87-2227] p 154 A87-48605  Space Station Information System integrated communications concept  [AIAA PAPER 87-2228] p 114 A87-48606  Space Station Information System requirements for integrated communications  [AIAA PAPER 87-2229] p 114 A87-48607	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DGLR PAPER 86-104] P 88 A87-36756  INTERNATIONAL COOPERATION Geostationary platforms - An international perspective p 121 A87-32288 Space Station - Overview of the European concept of Columbus programme status and content p 145 A87-32528 Contribution of the German Democratic Republic (East Germany) to the 'Intercosmos' program of study of materials in space aboard the orbiting station Salyut 6 p 147 A87-32814 International cooperation in space p 149 A87-32814 International cooperation operation: p 150 A87-37964 The Space Station overview p 188 A87-41571 Trends in space transportation p 168 A87-41571 Trends in space transportation p 168 A87-41572 Man's role in space exploration and exploitation p 169 A87-46332 Operational instruments on the Space Station-Polar Platforms - Contributions by NOAA and the international community p 127 A87-53149 The GDR and the Soviet space program - The optical instrument sector of the GDR contributions p 155 A87-53559 Cooperation between Europe and the United States in space (The Fulbright 40th Anniversary Lecture)	Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  JAPANESE SPACE PROGRAM  Japanese space program p 143 A87-32285 Space Station program in a long-range space development scenario of Japan p 145 A87-32530 Development of exposed deck of Japanese experiment module p 145 A87-32532 Japanese experiment module data management and communication system p 147 A87-32542 Japanese Experiment Module (JEM) preliminary design status p 151 A87-41570 Japan's space development programs for communications - An overview p 152 A87-43156 Japanese space information system overview [AIAA PAPER 87-2191] p 153 A87-48579 Japanese customer needs for Space Station [AIAA PAPER 87-2193] p 153 A87-48580  JAPANESE SPACECRAFT Status of Japanese Experiment Module design p 145 A87-32531 Japanese data relay satellite system [AIAA PAPER 87-2199] p 154 A87-48585  JET MIXING FLOW Mixing-induced ullage condensation and fluid destratification [AIAA PAPER 87-2018] p 92 A87-45357 Temperature fields due to jet induced mixing in a typical OTV tank [AIAA PAPER 87-2017] p 93 A87-52247
[AIAA PAPER 87-2981] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703  NFI-ATABLE STRUCTURES  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534  NFORMATION FLOW  Information network architectures p 116 N87-29149  NFORMATION MANAGEMENT  Technical and Management Information System (TMIS)  [AIAA PAPER 87-2217] p 114 A87-48600  NFORMATION SYSTEMS  Japanese space information system overview  [AIAA PAPER 87-2196] p 119 A87-48579  Scientific customer needs - NASA user  [AIAA PAPER 87-2205] p 119 A87-48582  Data management standards for space information systems  [AIAA PAPER 87-2205] p 113 A87-48590  Integrated scheduling and resource management for Space Station Information System  [AIAA PAPER 87-2217] p 114 A87-48600  [AIAA PAPER 87-2217] p 114 A87-48600  [AIAA PAPER 87-2217] p 114 A87-48600  Evolution of data management systems from Spacelab to Columbus  [AIAA PAPER 87-2227] p 154 A87-48605  Space Station Information System integrated communications concept  [AIAA PAPER 87-2228] p 114 A87-48606  Space Station Information System requirements for integrated communications  [AIAA PAPER 87-2228] p 114 A87-48606  Space Station Information System requirements for integrated communications  [AIAA PAPER 87-2228] p 114 A87-48606  Space Operations: NASA's use of information	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DGLR PAPER 86-104] INTERNATIONAL COOPERATION Geostationary platforms - An international perspective p 121 A87-32288 Space Station - Overview of the European concept of Columbus programme status and content p 145 A87-3258 Contribution of the German Democratic Republic (East Germany) to the 'Intercosmos' program of study of materials in space aboard the orbiting station Salyut 6 p 147 A87-32814 International cooperation in space p 149 A87-34594 Flunking on Space Station cooperation? p 150 A87-37964 The Space Station overview p 168 A87-41571 Trends in space transportation p 168 A87-41571 Trends in space exploration and exploitation p 169 A87-45322 Operational instruments on the Space Station-Polar Platforms - Contributions by NOAA and the international community p 127 A87-53149 The GDR and the Soviet space program - The optical instrument sector of the GDR contributions p 155 A87-53559 Cooperation between Europe and the United States in space (The Fulbright 40th Anniversary Lecture)	Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  Japanese Space Program Japanese space program p 143 A87-32285 Space Station program in a long-range space development scenario of Japan p 145 A87-32530 Development of exposed deck of Japanese experiment module p 145 A87-32532 Japanese experiment module data management and communication system p 147 A87-32532 Japanese experiment Module (JEM) preliminary design status Japan's space development p 151 A87-41570 Japan's space development communications - An overview p 152 A87-43156 Japanese space information system overview [AIAA PAPER 87-2191] p 153 A87-48579 Japanese customer needs for Space Station [AIAA PAPER 87-2193] p 153 A87-48580  JAPANESE SPACECRAFT Status of Japanese Experiment Module design p 145 A87-32531  Japanese data relay satellite system [AIAA PAPER 87-2199] p 154 A87-48585  JET MIXING FLOW Mixing-induced ullage condensation and fluid destratification [AIAA PAPER 87-2018] p 92 A87-45357  Temperature fields due to jet induced mixing in a typical OTV tank [AIAA PAPER 87-2017] p 93 A87-52247  JOINTS (JUNCTIONS)  Nonlinear transient analysis of joint dominated structures [AIAA PAPER 87-0892] p 17 A87-33709
[AIAÁ PAPER 87-293] p 58 A87-39644 NFECTIOUS DISEASES Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703 NFLATABLE STRUCTURES An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534 NFORMATION FLOW Information network architectures p 116 N87-29149 NFORMATION MANAGEMENT Technical and Management Information System (TMIS) [AIAA PAPER 87-2217] p 114 A87-48600 NFORMATION SYSTEMS Japanese space information system overview [AIAA PAPER 87-217] p 153 A87-48579 Scientific customer needs - NASA user [AIAA PAPER 87-2196] p 119 A87-48582 Data management standards for space information systems [AIAA PAPER 87-2205] p 113 A87-48590 Integrated scheduling and resource management for Space Station Information System [AIAA PAPER 87-2213] p 119 A87-48597 Technical and Management Information System [AIAA PAPER 87-2217] p 114 A87-48600 EVOLution of data management systems from Spacelab to Columbus [AIAA PAPER 87-2227] p 14 A87-48605 Space Station Information System requirements for integrated communications concept [AIAA PAPER 87-2228] p 114 A87-48606 Space Station Information System requirements for integrated communications [AIAA PAPER 87-2229] p 114 A87-48606 Space Station Information System requirements for integrated communications [AIAA PAPER 87-2229] p 114 A87-48607 Space operations: NASA's use of information technology. Report to the Chairman, Committee on Science, Space and Technology	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DGLR PAPER 86-104] INTERNATIONAL COOPERATION Geostationary platforms - An international perspective p 121 A87-32288 Space Station - Overview of the European concept of Columbus programme status and content p 145 A87-32528 Contribution of the German Democratic Republic (East Germany) to the 'Intercosmos' program of study of materials in space aboard the orbiting station Salyut 6 p 147 A87-3254 International cooperation in space p 149 A87-34594 Flunking on Space Station cooperation? The Space Station overview p 150 A87-37964 The Space Station overview p 168 A87-41571 Trends in space transportation p 169 A87-46332 Operational instruments on the Space Station-Polar Platforms - Contributions by NOAA and the international community p 127 A87-53149 The GDR and the Soviet space program - The optical instrument sector of the GDR contributions p 155 A87-53559 Cooperation between Europe and the United States in space (The Fulbright 40th Anniversary Lecture) p 170 A87-53924 Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-Sensing (ESPOIR)	Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  Japanese Space Program Japanese space program p 143 A87-32285 Space Station program in a long-range space development scenario of Japan p 145 A87-32530 Development of exposed deck of Japanese experiment module p 145 A87-32532 Japanese experiment module data management and communication system p 147 A87-32542 Japanese Experiment Module (JEM) preliminary design status p 151 A87-41570 Japan's space development p programs for communications - An overview p 152 A87-43156 Japanese space information system overview [AIAA PAPER 87-2191] p 153 A87-48579 Japanese customer needs for Space Station [AIAA PAPER 87-2193] p 153 A87-48580  JAPANESE SPACECRAFT Status of Japanese Experiment Module design p 145 A87-32531  Japanese data relay satellite system [AIAA PAPER 87-2199] p 154 A87-48585  JET MIXING FLOW Mixing-induced ullage condensation and fluid destratification [AIAA PAPER 87-2018] p 92 A87-45357 Temperature fields due to jet induced mixing in a typical OTV tank [AIAA PAPER 87-2017] p 93 A87-52247  JOINTS (JUNCTIONS) Nonlinear transient analysis of joint dominated structures [AIAA PAPER 87-0892] p 17 A87-33709 Joint technology for graphite epoxy space structures
[AIAÁ PAPER 87-2891] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703  NFLATABLE STRUCTURES  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534  NFORMATION FLOW  Information network architectures p 116 N87-29149  NFORMATION MANAGEMENT  Technical and Management Information System (TMIS)  [AIAA PAPER 87-2217] p 114 A87-48600  NFORMATION SYSTEMS  Japanese space information system overview  [AIAA PAPER 87-2196] p 153 A87-48579  Scientific customer needs - NASA user  [AIAA PAPER 87-2196] p 119 A87-48582  Data management standards for space information systems  [AIAA PAPER 87-2205] p 113 A87-48590  Integrated scheduling and resource management — for Space Station Information System  [AIAA PAPER 87-2213] p 119 A87-48597  Technical and Management Information System  [AIAA PAPER 87-2217] p 114 A87-48600  EVolution of data management systems from Spacelab to Columbus  [AIAA PAPER 87-2227] p 154 A87-48605  Space Station Information System requirements for integrated communications concept  [AIAA PAPER 87-2228] p 114 A87-48606  Space Station Information System requirements for integrated communications concept  [AIAA PAPER 87-2228] p 114 A87-48607  Space operations: NASA's use of information technology. Report to the Chairman, Committee on Science, Space and Technology  [GAO/IMTEC-87-20] p 137 N87-22551	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DGLR PAPER 86-104] INTERNATIONAL COOPERATION Geostationary platforms - An international perspective p 121 A87-32288 Space Station - Overview of the European concept of Columbus programme status and content p 145 A87-32528 Contribution of the German Democratic Republic (East Germany) to the "Intercosmos" program of study of materials in space aboard the orbiting station Salyut 6 p 147 A87-32814 International cooperation in space p 149 A87-34594 Flunking on Space Station cooperation? p 150 A87-37964 The Space Station overview p 168 A87-41571 Trends in space transportation p 168 A87-41572 Man's role in space exploration and exploitation p 169 A87-46332 Operational instruments on the Space Station-Polar Platforms - Contributions by NOAA and the international community p 127 A87-53149 The GDR and the Soviet space program - The optical instrument sector of the GDR contributions p 155 A87-53559 Cooperation between Europe and the United States in space (The Fulbright 40th Anniversary Lecture) p 170 A87-53924 Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-Sensing (ESPOIR) [ESA-SP-266] p 128 N87-20621 Cooperation of the International Space Station partners	Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  J JAPANESE SPACE PROGRAM Japanese space program p 143 A87-32285 Space Station program in a long-range space development scenario of Japan p 145 A87-32530 Development of exposed deck of Japanese experiment module p 145 A87-32532 Japanese experiment module data management and communication system p 147 A87-32532 Japanese Experiment Module (JEM) preliminary design status p 151 A87-41570 Japan's space development programs for communications - An overview p 152 A87-43156 Japanese space information system overview [AIAA PAPER 87-2191] p 153 A87-48580 JAPANESE SPACECRAFT Status of Japanese Experiment Module design p 145 A87-32531 Japanese data relay satellite system [AIAA PAPER 87-2199] p 154 A87-48585 JET MIXING FLOW Mixing-induced ullage condensation and fluid destratification [AIAA PAPER 87-2018] p 92 A87-45367 Temperature fields due to jet induced mixing in a typical OTV tank [AIAA PAPER 87-2017] p 93 A87-52247 JOINTS (JUNCTIONS) Nonlinear transient analysis of joint dominated structures [AIAA PAPER 87-0892] p 17 A87-33709 Joint technology for graphite epoxy space structures [AIAA PAPER 87-0892] p 17 A87-33709 Joint technology for graphite epoxy space structures
[AIAA PAPER 87-2991] p 58 A87-39644 NFECTIOUS DISEASES Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703 NFLATABLE STRUCTURES An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534 NFORMATION FLOW Information network architectures p 116 N87-29149 NFORMATION MANAGEMENT Technical and Management Information System (TMIS) [AIAA PAPER 87-2217] p 114 A87-48600 NFORMATION SYSTEMS Japanese space information system overview [AIAA PAPER 87-2191] p 153 A87-48579 Scientific customer needs - NASA user [AIAA PAPER 87-2191] p 119 A87-48582 Data management standards for space information systems [AIAA PAPER 87-2205] p 113 A87-48590 Integrated scheduling and resource management — for Space Station Information System [AIAA PAPER 87-2213] p 119 A87-48597 Technical and Management Information System [AIAA PAPER 87-2217] p 114 A87-48600 (TMIS) [AIAA PAPER 87-2227] p 154 A87-48600 (TMIS)	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DGLR PAPER 86-104] INTERNATIONAL COOPERATION Geostationary platforms - An international perspective p 121 A87-32288 Space Station - Overview of the European concept of Columbus programme status and content p 145 A87-32528 Contribution of the German Democratiic Republic (East Germany) to the "Intercosmos" program of study of materials in space aboard the orbiting station Salyut 6 p 147 A87-32814 International cooperation in space p 149 A87-34594 Flunking on Space Station cooperation? p 150 A87-37964 The Space Station overview p 168 A87-41571 Trends in space transportation p 188 A87-41572 Man's role in space exploration and exploitation p 169 A87-6332 Operational instruments on the Space Station-Polar Platforms - Contributions by NOAA and the international community p 127 A87-53149 The GDR and the Soviet space program - The optical instrument sector of the GDR contributions p 155 A87-53559 Cooperation between Europe and the United States in space (The Fulbright 40th Anniversary Lecture) p 170 A87-3924 Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-Sensing (ESPOIR) [ESA-SP-266] p 128 N87-20621 Cooperation of the international Space Station perments in the preparation of the use of space station elements	Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  Japanese space program p 143 A87-32285 Space Station program in a long-range space development scenario of Japan p 145 A87-32530 Development of exposed deck of Japanese experiment module p 145 A87-32532 Japanese experiment module data management and communication system p 147 A87-32542 Japanese Experiment Module (JEM) preliminary design status p 151 A87-41570 Japan's space development p programs for communications - An overview p 152 A87-43156 Japanese pace information system overview [AIAA PAPER 87-2191] p 153 A87-48579 Japanese customer needs for Space Station [AIAA PAPER 87-2193] p 153 A87-48580 JAPANESE SPACECRAFT Status of Japanese Experiment Module design p 145 A87-32531 Japanese data relay satellite system [AIAA PAPER 87-2199] p 154 A87-32531 Japanese data relay satellite system [AIAA PAPER 87-2018] p 92 A87-45357 Temperature fields due to jet induced mixing in a typical OTV tank [AIAA PAPER 87-2017] p 93 A87-52247 JOINTS (JUNCTIONS) Nonlinear transient analysis of joint dominated structures [AIAA PAPER 87-0892] p 17 A87-33709 Joint technology for graphite epoxy space structures [AIAA PAPER 87-2082] p 20 A87-38600 Development of precision structural joints for large space structures
[AIAA PAPER 87-291] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703  NFIATABLE STRUCTURES  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534  NFORMATION FLOW  Information network architectures p 116 N87-29149  NFORMATION MANAGEMENT  Technical and Management Information System (TMIS)  [AIAA PAPER 87-2217] p 114 A87-48600  NFORMATION SYSTEMS  Japanese space information system overview  [AIAA PAPER 87-2191] p 153 A87-48579  Scientific customer needs - NASA user  [AIAA PAPER 87-2196] p 119 A87-48582  Data management standards for space information systems  [AIAA PAPER 87-2205] p 113 A87-48590  Integrated scheduling and resource management for Space Station Information System  [AIAA PAPER 87-2213] p 119 A87-48597  Technical and Management Information System  [AIAA PAPER 87-2217] p 114 A87-48600  EVOlumbus  [AIAA PAPER 87-2227] p 154 A87-48605  Space Station Information System requirements for integrated communications concept  [AIAA PAPER 87-2228] p 114 A87-48606  Space Station Information System requirements for integrated communications  [AIAA PAPER 87-2228] p 114 A87-48607  Space operations: NASA's use of information technology. Report to the Chairman, Committee on Science, Space and Technology  [GAO/IMTEC-87-20] p 137 N87-22551  Remote Sensing Information Sciences Research Group; year 4	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DGLR PAPER 86-104] INTERNATIONAL COOPERATION Geostationary platforms - An international perspective p 121 A87-32288 Space Station - Overview of the European concept of Columbus programme status and content p 145 A87-32528 Contribution of the German Democratic Republic (East Germany) to the "Intercosmos" program of study of materials in space aboard the orbiting station Salyut 6 p 147 A87-32814 International cooperation in space p 149 A87-34594 Flunking on Space Station cooperation? p 150 A87-37964 The Space Station overview p 168 A87-41571 Trends in space transportation p 168 A87-41572 Man's role in space exploration and exploitation p 169 A87-46332 Operational instruments on the Space Station-Polar Platforms - Contributions by NOAA and the international community p 127 A87-53149 The GDR and the Soviet space program - The optical instrument sector of the GDR contributions p 155 A87-53559 Cooperation between Europe and the United States in space (The Fulbright 40th Anniversary Lecture) p 170 A87-53924 Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-Sensing (ESPOIR) [ESA-SP-266] p 128 N87-20621 Cooperation of the International Space Station partners	Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  J JAPANESE SPACE PROGRAM Japanese space program p 143 A87-32285 Space Station program in a long-range space development scenario of Japan p 145 A87-32530 Development of exposed deck of Japanese experiment module p 145 A87-32532 Japanese experiment module data management and p 147 A87-32532 Japanese experiment Module (JEM) preliminary design status p 151 A87-41570 Japan's space development p 152 A87-41570 Japan's space development p 152 A87-43156 Japanese space information system overview [AIAA PAPER 87-2191] p 153 A87-48580 JAPANESE SPACECRAFT Status of Japanese Experiment Module design p 145 A87-32531 Japanese data relay satellite system [AIAA PAPER 87-2199] p 154 A87-48585 JET MIXING FLOW Mixing-induced ullage condensation and fluid destratification [AIAA PAPER 87-2018] p 92 A87-45367 Temperature fields due to jet induced mixing in a typical OTV tank [AIAA PAPER 87-2017] p 93 A87-52247 JOINTS (JUNCTIONS) Nonlinear transient analysis of joint dominated structures [AIAA PAPER 87-0892] p 17 A87-33709 Joint technology for graphite epoxy space structures [AIAA PAPER 87-0892] p 17 A87-33709 Joint technology for graphite epoxy space structures
[AIAA PAPER 87-2931] p 58 A87-39644 NFECTIOUS DISEASES Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703 NFLATABLE STRUCTURES An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534 NFORMATION FLOW Information network architectures p 116 N87-29149 NFORMATION MANAGEMENT Technical and Management Information System (TMIS) [AIAA PAPER 87-2217] p 114 A87-48600 NFORMATION SYSTEMS Japanese space information system overview [AIAA PAPER 87-2191] p 153 A87-48579 Scientific customer needs - NASA user [AIAA PAPER 87-2196] p 119 A87-48582 Data management standards for space information systems [AIAA PAPER 87-2205] p 113 A87-48590 Integrated scheduling and resource management for Space Station Information System [AIAA PAPER 87-2213] p 119 A87-48597 Technical and Management Information System [AIAA PAPER 87-2217] p 114 A87-48606 [AIAA PAPER 87-2227] p 154 A87-48606 [AIAA PAPER 87-2228] p 114 A87-48606 [AIAA PAPER 87-2229] p 117 A87-22551 [AIAA PAPER 87-2225] p 117 A87-22551 [AIAA PAPER 87-2225] p 118 A87-22551 [AIAA PAPER 87-22551] P 118 A87-22551 [AIAA PAPER 87-2258] P 118 A87-22551 [AIAA PAPER 87-	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DGLR PAPER 86-104] INTERNATIONAL COOPERATION Geostationary platforms - An international perspective p 121 A87-32288 Space Station - Overview of the European concept of Columbus programme status and content p 145 A87-32528 Contribution of the German Democratic Republic (East Germany) to the "Intercosmos" program of study of materials in space aboard the orbiting station Salyut 6 p 147 A87-32814 International cooperation in space p 149 A87-32814 International cooperation in space p 149 A87-34594 Flunking on Space Station cooperation? p 150 A87-37964 The Space Station overview p 168 A87-41571 Trends in space transportation p 168 A87-41572 Man's role in space exploration and exploitation p 169 A87-46332 Operational instruments on the Space Station-Polar Platforms - Contributions by NOAA and the international community p 127 A87-53149 The GDR and the Soviet space program - The optical instrument sector of the GDR contributions p 155 A87-53559 Cooperation between Europe and the United States in space (The Fulbright 40th Anniversary Lecture) p 170 A87-53924 Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-Sensing (ESPOIR) [ESA-SP-266] p 128 N87-20621 Cooperation of the International Space Station partners in the preparation of the International Space Station partners in the preparation of the International Space Station partners in the preparation of the International Space Station elements for Earth observation (platform and payload aspects) p 128 N87-20631 USA-Europe coordination and cooperation activities:	DOOSPHERIC PROPAGATION Design of a beacon receiving system for the Olympus satellite  J  JAPANESE SPACE PROGRAM Japanese space program Space Station program in a long-range space development scenario of Japan Development of exposed deck of Japanese experiment module Development module data management and communication system Development Module (JEM) preliminary design status Development Module (JEM) preliminary design programs for communications - An overview Development of exposed development programs for communications - An overview Development of programs for communications - An overview programs for programs for programs for communications - A87-48580 Japanese customer needs for Space Station [AIAA PAPER 87-2193] prisa A87-48580 Japanese data relay satellite system [AIAA PAPER 87-2019] prisa A87-48585 [AIAA PAPER 87-2018] prisa A87-48585 [AIAA PAPER 87-2017] prisa A87-45357 [AIAA PAPER 87-2017] prisa A87-45357 [AIAA PAPER 87-2017] prisa A87-45360 [AIAA PAPER 87-2017] prisa A87-45360 [AIAA PAPER 87-2017] prisa A87-45360 [AIAA PAPER 87-2017] prisa A87-33600 [AIAA PAPER 87-0892] prisa A87-33709 [AIAA PAPER 87-0892] prisa A
[AIAA PAPER 87-291] p 58 A87-39644  NFECTIOUS DISEASES  Expansion of space station diagnostic capability to include serological identification of viral and bacterial infections p 53 N87-26703  NFIATABLE STRUCTURES  An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534  NFORMATION FLOW  Information network architectures p 116 N87-29149  NFORMATION MANAGEMENT  Technical and Management Information System (TMIS)  [AIAA PAPER 87-2217] p 114 A87-48600  NFORMATION SYSTEMS  Japanese space information system overview  [AIAA PAPER 87-2191] p 153 A87-48579  Scientific customer needs - NASA user  [AIAA PAPER 87-2196] p 119 A87-48582  Data management standards for space information systems  [AIAA PAPER 87-2205] p 113 A87-48590  Integrated scheduling and resource management for Space Station Information System  [AIAA PAPER 87-2213] p 119 A87-48597  Technical and Management Information System  [AIAA PAPER 87-2217] p 114 A87-48600  EVOlumbus  [AIAA PAPER 87-2227] p 154 A87-48605  Space Station Information System requirements for integrated communications concept  [AIAA PAPER 87-2228] p 114 A87-48606  Space Station Information System requirements for integrated communications  [AIAA PAPER 87-2228] p 114 A87-48607  Space operations: NASA's use of information technology. Report to the Chairman, Committee on Science, Space and Technology  [GAO/IMTEC-87-20] p 137 N87-22551  Remote Sensing Information Sciences Research Group; year 4	New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  INTERFACIAL TENSION Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer space [DGLR PAPER 86-104] INTERNATIONAL COOPERATION Geostationary platforms - An international perspective p 121 A87-32288 Space Station - Overview of the European concept of Columbus programme status and content p 145 A87-32288 Contribution of the German Democratic Republic (East Germany) to the 'Intercosmos' program of study of materials in space aboard the orbiting station Salyut 6 p 147 A87-32814 International cooperation in space p 149 A87-32814 International cooperation in space p 149 A87-34594 Flunking on Space Station cooperation? p 150 A87-37964 The Space Station overview p 188 A87-41571 Trends in space transportation p 188 A87-41572 Man's role in space exploration and exploitation p 169 A87-46332 Operational instruments on the Space Station-Polar Platforms - Contributions by NOAA and the international community p 127 A87-53149 The GDR and the Soviet space program - The optical instrument sector of the GDR contributions p 155 A87-53559 Cooperation between Europe and the United States in space (The Fulbright 40th Anniversary Lecture) p 170 A87-53924 Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-Sensing (ESPOIR) [ESA-SP-266] p 128 N87-20621 Cooperation of the International Space Station partners in the preparation of the use of space station elements for Earth observation (platform and psyload aspects) p 128 N87-20631	Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  Japanese Space Program Japanese space program p 143 A87-32285 Space Station program in a long-range space development scenario of Japan p 145 A87-32530 Development of exposed deck of Japanese experiment module p 145 A87-32532 Japanese experiment module data management and communication system p 151 A87-32532 Japanese Experiment Module (JEM) preliminary design status p 151 A87-41570 Japan's space development programs for communications - An overview p 152 A87-43156 Japanese space information system overview [AIAA PAPER 87-2191] p 153 A87-48580 JAPANESE SPACECRAFT Status of Japanese Experiment Module design p 145 A87-32531 Japanese data relay satellite system [AIAA PAPER 87-2199] p 154 A87-48585 JET MIXING FLOW Mixing-induced ullage condensation and fluid destratification [AIAA PAPER 87-2018] p 92 A87-45367 Temperature fields due to jet induced mixing in a typical OTV tank [AIAA PAPER 87-2017] p 93 A87-52247 JOINTS (JUNCTIONS) Nonlinear transient analysis of joint dominated structures [AIAA PAPER 87-0892] p 17 A87-33709 Joint technology for graphite epoxy space structures [AIAA PAPER 87-8092] p 17 A87-33709 Joint technology for graphite epoxy space structures p 28 N87-20374 Modeling of joints for the dynamic analysis of truss structures

p 24 A87-50445

maneuvers

p 56 A87-33713

[AIAA PAPER 87-2324]

	and the dimensional	High speed simulation of multi-flexible-body systems
Structural Dynamics and Control Interaction of Flexible	Deployable surface truss concepts and two-dimensional adaptive structures p 144 A87-32341	with large rotations
Structures	acapare 0	[AIAA PAPER 87-0930] p 57 A87-33730
[NASA-CP-2467-PT-2] p 66 N87-22729	Development of graphite epoxy space structure	An experimental study of transient waves in a plane
Experimental characterization of deployable trusses and	p 105 A87-32342	grid structure
joints p 33 N87-22749	Local control for large space structures	[AIAA PAPER 87-0943] p 18 A87-33741
Box truss antenna technology status	p 54 A87-32440	Wave propagation in periodic truss structures
p 87 N87-24503	A consideration to vibration control for a large space	[AIAA PAPER 87-0944] p 18 A87-33742
Response of joint dominated space structures	structures p 54 A87-32441	Localization of vibrations in large space reflectors
[NASA-CR-180564] p 36 N87-26071	Two-time-scale design of robust controllers for large	[AIAA PAPER 87-0949] p 18 A87-33745
Joint nonlinearity effects in the design of a flexible truss	structure systems p 12 A87-32443	On sine dwell or broadband methods for modal testing
structure control system	Vibration control for a linked system of flexible	(AIAA PAPER 87-0961) p 18 A87-33752
[NASA-CR-180633] p 37 N87-26365	structures p 55 A87-32444	Optimal placement of excitations and sensors for
Response of joint dominated space structures	A preliminary study on a linear inertial actuator for LSS	verification of large dynamical systems
[NASA-CR-181202] p 37 N87-26397	control p 55 A87-32447	(AIAA PAPER 87-0782) p 19 A87-33755
Substructure analysis using NICE/SPAR and	An enclosed hangar concept for large spacecraft	Alternative methods to fold/deploy tetrahedral or
applications of force to linear and nonlinear structures	servicing at Space Station p 146 A87-32534	pentahedral truss platforms p 19 A87-34467
spacecraft masts [NASA-CR-180317] p 38 N87-27260	Study of actuator for large space manipulator arm	On a balanced passive damping and active vibration
	p 12 A87-32545	suppression of large space structures
Preloaded space structural coupling joints [NASA-CASF-LAR-13489-1] p 38 N87-27713	Structure and function of Deployable Truss Beam	[AIAA PAPER 87-0901] p 19 A87-34701
TIMON-ONGE BUT TO TO TO		A study on singularity of single gimbal CMG systems
Space Station alpha joint bearing p 83 N87-29882	(DTB) p 12 A67-32346  MOVER II - A computer program for verifying	p 149 A87-35077
.,	MOVER II - A computer program for vernying	Reduced modeling and analysis of large repetitive space
K	reduced-order models of large dynamic systems [SAF PAPER 861790] p.5 A87-32639	structures via continuum/discrete concepts
		p 19 A87-35327
KALMAN FILTERS	An assessment of recent advances in modeling and	Composite tubes for the Space Station truss structure
Square root state estimator for large space structures	control design of space structures under uncertainty	p 20 A87-38601
[AIAA PAPER 87-2389] p 24 A87-50473	[SAE PAPER 861818] p 147 A87-32655	Quality monitoring in two-phase heat transport systems
KAPTON (TRADEMARK)	Static shape control for flexible structures	for large spacecraft [SAF PAPER 860959] p 42 A87-38743
The Vanderbilt University neutral O-beam facility	[SAE PAPER 861822] p 13 A87-32658	
p 105 A87-32059	Development status of a two-phase thermal	Control of flexible structures by applied thermal
Surface modification to minimise the electrostatic	management system for large spacecraft	gradients p 21 A87-39543
charging of Kapton in the space environment	[SAE PAPER 861828] p 41 A87-32662	The design and analysis of passive damping for
p 87 N87-26959	Environmental avoidance concepts for steerable Space	aerospace systems [AIAA PAPER 87-0891] p 58 A87-39644
MARECS and ECS anomalies: Attempt at insulation	Station radiators	
defect production in Kapton p 82 N87-28980	[SAE PAPER 861831] p 41 A87-32665	Deployment dynamics of space structures p 58 A87-40074
KINEMATICS	Guidance and control 1986; Proceedings of the Annual	Incorporation of the effects of material damping and
Notes on implementation of Coulomb friction in coupled	Rocky Mountain Guidance and Control Conference,	nonlinearities on the dynamics of space structures
dynamical simulations p 67 N87-22746	Keystone, CO, Feb. 1-5, 1986 p 55 A87-32/26	p 21 A87-40075
KINESTHESIA	The Mast Flight System dynamic characteristics and	New time-domain identification technique for vibrating
ISOKIN - A quantitative model of the kinesthetic aspects	actuator/sensor selection and location	structures p 58 A87-40869
of spatial habitability p 162 A87-33002	[AAS PAPER 86-003] p 13 A87-32729	Dynamic analysis and experiment methods for a generic
KINETIC ENERGY	Low-authority control through passive damping	space station model p 22 A87-41613
System identification for large space structure damage	[AAS PAPER 86-004] p 55 A87-32730	Inadequacy of single-impulse transfers for path
association	Solar array flight dynamic experiment  [AAS PAPER 86-050] p 75 A87-32747	constrained rendezvous p 90 A87-41615
KINETICS  Dynamics of an actively controlled flexible Earth	[AAS PAPER 86-050] p 75 A87-32747 An equivalent continuum analysis procedure for Space	Interdisciplinary analysis procedures in the modeling and
		control of large space-based structures
observation satellite p 71 N87-25356	Station lattice structures	control of large space-based structures p 22 A87-42678
	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564	p 22 A87-42678
	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer	p 22 A87-42678  A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module
	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration	p 22 A87-42678 A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-43354
observation satellite p 71 N87-25356	Station lattice structures [AIAA PAPER 87-0724]  A Lanczos eigenvalue method on a parallel computer  for large complex space structure free vibration analysis	p 22 A87-42678 A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-43354 Flexible system model reduction and control system
observation satellite p 71 N87-25356	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565	p 22 A87-42678 A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-43354 Flexible system model reduction and control system design based upon actuator and sensor influence
L-SAT Infrared test technique validation on the Olympus satellite	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-43354  Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301
L-SAT Infrared test technique validation on the Olympus satellite ISAF PAPER 8609391 p 150 A87-38728	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-43354  Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus spacecraft	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-4354  Flexible system model reduction and control system design based upon actuator and sensor influence functions  An approach to structure/control simultaneous optimization for large flexible spacecraft
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus space-craft p 152 A87-42266	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-4354  Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301  An approach to structure/control simultaneous optimization for large flexible spacecraft p 22 A87-4673
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus space-craft p 152 A87-42266	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module  P 125 A87-43354  Flexible system model reduction and control system design based upon actuator and sensor influence functions  An approach to structure/control simultaneous optimization for large flexible spacecraft  P 22 A87-46793  Space Station business  P 169 A87-47726
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus spacecraft	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-4354  Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301  An approach to structure/control simultaneous optimization for large flexible spacecraft  Space Station business p 169 A87-47726  Robust multivariable control of large space structures
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite p 86 A87-50157	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-4354  Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301  An approach to structure/control simultaneous optimization for large flexible spacecraft p 22 A87-46793  Space Station business p 169 A87-47726  Robust multivariable control of large space structures using positivity p 59 A87-47810
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite p 86 A87-50157	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module  P 125 A87-43354  Flexible system model reduction and control system design based upon actuator and sensor influence functions  p 59 A87-46301  An approach to structure/control simultaneous optimization for large flexible spacecraft  p 22 A87-46793  Space Station business  p 169 A87-47726  Robust multivariable control of large space structures using positivity  Perturbation analysis of internal balancing for lightly
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite p 86 A87-50157 LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropoellant resistojet	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-4354  Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301  An approach to structure/control simultaneous optimization for large flexible spacecraft  Space Station business p 169 A87-47786  Robust multivariable control of large space structures using positivity p 59 A87-47810  Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and
cobservation satellite p 71 N87-25356  L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 New concepts of deployable truss units for large space	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-4354  Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301  An approach to structure/control simultaneous optimization for large flexible spacecraft p 22 A87-47782  Robust multivariable control of large space structures using positivity p 59 A87-47810  Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 22 A87-47810
cobservation satellite p 71 N87-25356  L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus space-craft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237  LAGRANGIAN EQUILIBRIUM POINTS	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 New concepts of deployable truss units for large space structures	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-43354 Flexible system model reduction and control system design based upon actuator and sensor influence functions An approach to structure/control simultaneous optimization for large flexible spacecraft p 22 A87-46793 Space Station business p 169 A87-47726 Robust multivariable control of large space structures using positivity p 59 A87-47810 Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 22 A87-47812 Flexibility effects - Estimation of the stiffness matrix in
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite p 86 A87-50157 LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 New concepts of deployable truss units for large space structures [AIAA PAPER 87-0868] p 14 A87-33632	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-4354  Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301  An approach to structure/control simultaneous optimization for large flexible spacecraft  Space Station business p 169 A87-47786  Robust multivariable control of large space structures using positivity perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 22 A87-47812  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite p 86 A87-50157 LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32286	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 New concepts of deployable truss units for large space structures [AIAA PAPER 87-0868] p 14 A87-33632 On orbit damage assessment for large space	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-4354  Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301  An approach to structure/control simultaneous optimization for large flexible spacecraft  Space Station business p 169 A87-47796  Robust multivariable control of large space structures using positivity p 59 A87-47810  Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 22 A87-47812  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714  Modeling and control of torsional vibrations in a flexible
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-99854] p 96 N87-22237 LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32286 Stability in the relative equilibrium positions of space	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 New concepts of deployable truss units for large space structures [AIAA PAPER 87-0868] p 14 A87-33632 On orbit damage assessment for large space structures	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module  p 125 A87-43345  Flexible system model reduction and control system design based upon actuator and sensor influence functions  An approach to structure/control simultaneous optimization for large flexible spacecraft  p 22 A87-46793  Space Station business p 169 A87-47726  Robust multivariable control of large space structures using positivity p 59 A87-47810  Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 22 A87-4812  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714  Modeling and control of torsional vibrations in a flexible structure p 60 A87-50033
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite p 86 A87-50157 LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-99854] p 96 N87-22237 LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32286 Stability in the relative equilibrium points in the	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 New concepts of deployable truss units for large space structures [AIAA PAPER 87-0868] p 14 A87-33632 On orbit damage assessment for large space structures [AIAA PAPER 87-0870] p 15 A87-33634	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-4354  Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301  An approach to structure/control simultaneous optimization for large flexible spacecraft  Space Station business p 169 A87-4780  Robust multivariable control of large space structures using positivity p 59 A87-47810  Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 122 A87-47812  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714  Modeling and control of torsional vibrations in a flexible structure  Construction of positive real compensation for LSS
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite p 86 A87-50157 LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-99854] p 96 N87-22237 LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32286 Stability in the relative equilibrium points in the	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 New concepts of deployable truss units for large space structures [AIAA PAPER 87-0868] p 14 A87-33632 On orbit damage assessment for large space structures [AIAA PAPER 87-0870] p 15 A87-33634 Design considerations for a one-kilometer antenna stick	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-4354  Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301  An approach to structure/control simultaneous optimization for large flexible spacecraft  Space Station business p 169 A87-46793  Space Station business p 169 A87-47726  Robust multivariable control of large space structures using positivity  Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 22 A87-4712  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714  Modeling and control of torsional vibrations in a flexible structure p 60 A87-50033  Construction of positive real compensation for LSS control applied to Large Space Structure model
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus space-craft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite p 86 A87-50157 LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32286 Stability in the relative equilibrium points in the photogravitational three-body problem p 1 A87-32802	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 New concepts of deployable truss units for large space structures [AIAA PAPER 87-0868] p 14 A87-33632 On orbit damage assessment for large space structures [AIAA PAPER 87-0870] p 15 A87-33634 Design considerations for a one-kilometer antenna stick	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-4354  Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301  An approach to structure/control simultaneous optimization for large flexible spacecraft p 22 A87-46793  Space Station business p 169 A87-47726  Robust multivariable control of large space structures using positivity p 59 A87-47810  Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 22 A87-47812  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714  Modeling and control of torsional vibrations in a flexible structure  Construction of positive real compensation for LSS control applied to Large Space Structure model  [AIAA PAPER 87-2238] p 60 A87-50404
L-SAT Infrared test technique validation on the Olympus satellite  [SAE PAPER 860939] Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite Design of a beacon receiving system for the Olympus satellite LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-98854] P 96 N87-22237 LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding P 166 A87-32286 Stability in the relative equilibrium positions of space stations at triangular libration points in the photogravitational three-body problem P 1 A87-32802	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 New concepts of deployable truss units for large space structures [AIAA PAPER 87-0868] p 14 A87-33632 On orbit damage assessment for large space structures [AIAA PAPER 87-0870] p 15 A87-33634 Design considerations for a one-kilometer antenna stick [AIAA PAPER 87-0871] p 15 A87-33635	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module  p 125 A87-4334  Flexible system model reduction and control system design based upon actuator and sensor influence functions  An approach to structure/control simultaneous optimization for large flexible spacecraft  p 22 A87-46301  An approach to structure/control simultaneous optimization for large flexible spacecraft  p 22 A87-46793  Space Station business p 169 A87-47726  Robust multivariable control of large space structures using positivity p 59 A87-47810  Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 22 A87-4812  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714  Modeling and control of torsional vibrations in a flexible structure p 60 A87-50033  Construction of positive real compensation for LSS control — applied to Large Space Structure model [AIAA PAPER 87-2238] p 60 A87-50404  Low-authority control of large space structures by using
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite p 86 A87-50157 LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-99854] p 96 N87-22237 LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32286 Stability in the relative equilibrium positions of space stations at triangular libration points in the photogravitational three-body problem p 1 A87-32802 LAMINATES Taylored laminates with null or arbitrary coefficient of	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 New concepts of deployable truss units for large space structures [AIAA PAPER 87-0868] p 14 A87-33632 On orbit damage assessment for large space structures [AIAA PAPER 87-0870] p 15 A87-33634 Design considerations for a one-kilometer antenna stick [AIAA PAPER 87-0871] p 15 A87-33635 Identification of the zero-g shape of a space beam [AIAA PAPER 87-0872] p 15 A87-33636	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-4354  Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301  An approach to structure/control simultaneous optimization for large flexible spacecraft  Space Station business p 169 A87-47793  Space Station business p 169 A87-47794  Robust multivariable control of large space structures using positivity Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 122 A87-47812  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714  Modeling and control of torsional vibrations in a flexible structure  Construction of positive real compensation for LSS control applied to Large Space Structure model [AIAA PAPER 87-2238] p 60 A87-50404  Low-authority control of large space structures by using tendon control system
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus space-craft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32286 Stability in the relative equilibrium points in the photogravitational three-body problem p 1 A87-32802 LAMINATES Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 New concepts of deployable truss units for large space structures [AIAA PAPER 87-0868] p 14 A87-33632 On orbit damage assessment for large space structures [AIAA PAPER 87-0870] p 15 A87-33634 Design considerations for a one-kilometer antenna stick [AIAA PAPER 87-0871] p 15 A87-33635 Identification of the zero-g shape of a space beam [AIAA PAPER 87-0872] p 15 A87-33636	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module  Flexible system model reduction and control system design based upon actuator and sensor influence functions  An approach to structure/control simultaneous optimization for large flexible spacecraft  p 22 A87-46793  Space Station business  p 22 A87-47793  Robust multivariable control of large space structures using positivity  Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure  p 22 A87-47810  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure  p 23 A87-48714  Modeling and control of torsional vibrations in a flexible structure  p 60 A87-50033  Construction of positive real compensation for LSS control — applied to Large Space Structure model  [AIAA PAPER 87-2238]  p 60 A87-50404  Low-authority control of large space structures by using tendon control system  [AIAA PAPER 87-2249]
L-SAT Infrared test technique validation on the Olympus satellite  [SAE PAPER 860939] p 150 A87-38728  Modal-survey testing of the Olympus spacecraft p 152 A87-42266  Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-99854] p 96 N87-22237  LAGRANGIAN EQUILIBRIUM POINTS  Space colonization - T minus 20 (years) and holding p 166 A87-32286  Stability in the relative equilibrium positions of space stations at triangular libration points in the photogravitational three-body problem p 1 A87-32802  LAMINATES Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794  LARGE SCALE INTEGRATION	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-4354  Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301  An approach to structure/control simultaneous optimization for large flexible spacecraft  Space Station business p 169 A87-47793  Space Station business p 169 A87-47794  Robust multivariable control of large space structures using positivity Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 122 A87-47812  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714  Modeling and control of torsional vibrations in a flexible structure  Construction of positive real compensation for LSS control applied to Large Space Structure model [AIAA PAPER 87-2238] p 60 A87-50404  Low-authority control of large space structures by using tendon control system
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus space-craft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32286 Stability in the relative equilibrium points in the photogravitational three-body problem p 1 A87-32802 LAMINATES Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 New concepts of deployable truss units for large space structures [AIAA PAPER 87-0868] p 14 A87-33632 On orbit damage assessment for large space structures [AIAA PAPER 87-0870] p 15 A87-33634 Design considerations for a one-kilometer antenna stick [AIAA PAPER 87-0871] p 15 A87-33635 Identification of the zero-g shape of a space beam [AIAA PAPER 87-0872] p 15 A87-33636 Dynamical response to pulse excitations in large space structures [AIAA PAPER 87-0710] p 15 A87-33658	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-4354  Flexible system model reduction and control system design based upon actuator and sensor influence functions and approach to structure/control simultaneous optimization for large flexible spacecraft  Space Station business p 169 A87-47726 Robust multivariable control of large space structures using positivity p 59 A87-4770 Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 122 A87-47814  Modeling and control of torsional vibrations in a flexible structure p 23 A87-4814  Modeling and control of torsional vibrations in a flexible structure p 20 A87-50033  Construction of positive real compensation for LSS control — applied to Large Space Structure model [AIAA PAPER 87-2238] p 60 A87-50404  Low-authority control of large space structures by using tendon control system [AIAA PAPER 87-2249] p 60 A87-50413  The control of linear dampers for large space structures
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] Modal-survey testing of the Olympus space-craft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite  LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854]  LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32286  Stability in the relative equilibrium positions of space stations at triangular libration points in the photogravitational three-body problem p 1 A87-32802  LAMINATES Taylored laminates with null or arbitrary coefficient of thermal expansion  LARGE SCALE INTEGRATION S focused technology: Gateways and NOS's p 117 N87-29165	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 New concepts of deployable truss units for large space structures [AIAA PAPER 87-0868] p 14 A87-33632 On orbit damage assessment for large space structures [AIAA PAPER 87-0870] p 15 A87-33634 Design considerations for a one-kilometer antenna stick [AIAA PAPER 87-0871] p 15 A87-33635 Identification of the zero-g shape of a space beam [AIAA PAPER 87-0872] p 15 A87-33636 Dynamical response to pulse excitations in large space structures [AIAA PAPER 87-0710] p 15 A87-33658 Vibration suppression using a constrained rate-feedback	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-43354 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 An approach to structure/control simultaneous optimization for large flexible spacecraft  Space Station business p 169 A87-47726 Robust multivariable control of large space structures using positivity Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714 Modeling and control of torsional vibrations in a flexible structure Construction of positive real compensation for LSS control applied to Large Space Structure model [AIAA PAPER 87-2238] p 60 A87-50404 Low-authority control of large space structures by using tendon control system [AIAA PAPER 87-2249] p 60 A87-50413 The control of linear dampers for large space structures
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite p 86 A87-50157 LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-99854] p 96 N87-22237 LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32286 Stability in the relative equilibrium positions of space stations at triangular libration points in the photogravitational three-body problem p 1 A87-32802 LAMINATES Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 LARGE SCALE INTEGRATION SS focused technology: Gateways and NOS's p 117 N87-29165 LARGE SPACE STRUCTURES	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 New concepts of deployable truss units for large space structures [AIAA PAPER 87-0868] p 14 A87-33632 On orbit damage assessment for large space structures [AIAA PAPER 87-0870] p 15 A87-33636 Design considerations for a one-kilometer antenna stick [AIAA PAPER 87-0871] p 15 A87-33636 [AIAA PAPER 87-0872] p 15 A87-33636 Dynamical response to pulse excitations in large space structures [AIAA PAPER 87-0710] p 15 A87-33658 Vibration suppression using a constrained rate-feedback Threshold control strategy for large space structures	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module  Flexible system model reduction and control system design based upon actuator and sensor influence functions  An approach to structure/control simultaneous optimization for large flexible spacecraft  p 22 A87-46793  Space Station business p 169 A87-47726  Robust multivariable control of large space structures using positivity p 59 A87-47810  Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 22 A87-48714  Modeling and control of torsional vibrations in a flexible structure  Construction of positive real compensation for LSS control — applied to Large Space Structure model  [AIAA PAPER 87-2238] p 60 A87-50404  Low-authority control of large space structures by using tendon control of linear dampers for large space structures  [AIAA PAPER 87-2249] p 60 A87-50413  The control of linear dampers for large space structures  [AIAA PAPER 87-2251] p 60 A87-50415  Robust eigensystem assignment for flexible structures
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] Modal-survey testing of the Olympus space-craft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite  LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854]  LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32286  Stability in the relative equilibrium positions of space stations at triangular libration points in the photogravitational three-body problem p 1 A87-32802  LAMINATES Taylored laminates with null or arbitrary coefficient of thermal expansion  LARGE SCALE INTEGRATION S focused technology: Gateways and NOS's p 117 N87-29165	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 New concepts of deployable truss units for large space structures [AIAA PAPER 87-0868] p 14 A87-33632 On orbit damage assessment for large space structures [AIAA PAPER 87-0870] p 15 A87-33634 Design considerations for a one-kilometer antenna stick [AIAA PAPER 87-0871] p 15 A87-33635 Identification of the zero-g shape of a space beam [AIAA PAPER 87-0872] p 15 A87-33636 Dynamical response to pulse excitations in large space structures [AIAA PAPER 87-0710] p 15 A87-33658 Vibration suppression using a constrained rate-feedback Threshold control strategy for large space structures [AIAA PAPER 87-0741] p 6 A87-33665	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-4378.  Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301. An approach to structure/control simultaneous optimization for large flexible spacecraft p 22 A87-46793. Space Station business p 169 A87-47726. Robust multivariable control of large space structures using positivity p 59 A87-47810. Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 22 A87-47812. Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714. Modeling and control of torsional vibrations in a flexible structure. Construction of positive real compensation for LSS control applied to Large Space Structure model [AIAA PAPER 87-2238] p 60 A87-50404. Low-authority control of large space structures by using tendon control of linear dampers for large space structures [AIAA PAPER 87-2251] p 60 A87-50415. Robust eigensystem assignment for flexible structures [AIAA PAPER 87-2251] p 60 A87-50416.
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32286 Stability in the relative equilibrium positions of space stations at triangular libration points in the photogravitational three-body problem p 1 A87-32802 LAMINATES Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 LARGE SCALE INTEGRATION SS focused technology: Gateways and NOS's p 117 N87-29165 LARGE SPACE STRUCTURES Fiber-optic monitors for space structures	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 New concepts of deployable truss units for large space structures [AIAA PAPER 87-0868] p 14 A87-33632 On orbit damage assessment for large space structures [AIAA PAPER 87-0870] p 15 A87-33634 Design considerations for a one-kilometer antenna stick [AIAA PAPER 87-0871] p 15 A87-33635 Identification of the zero-g shape of a space beam [AIAA PAPER 87-0872] p 15 A87-33636 Dynamical response to pulse excitations in large space structures [AIAA PAPER 87-0710] p 15 A87-33658 Vibration suppression using a constrained rate-feedback Threshold control strategy for large space structures [AIAA PAPER 87-0741] p 6 A87-33665 System identification of a truss type space structure	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-4354  Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301  An approach to structure/control simultaneous optimization for large flexible spacecraft  Space Station business p 169 A87-47786  Robust multivariable control of large space structures using positivity Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714  Modeling and control of torsional vibrations in a flexible structure p 60 A87-50043  Construction of positive real compensation for LSS control applied to Large Space Structure model [AIAA PAPER 87-2238] p 60 A87-50404  Low-authority control of large space structures by using tendon control system  [AIAA PAPER 87-2251] p 60 A87-50413  The control of linear dampers for large space structures  [AIAA PAPER 87-2251] p 60 A87-50415  Robust eigensystem assignment for flexible structures  [AIAA PAPER 87-2252] p 23 A87-50416  Robust control of a large space antenna
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite p 86 A87-50157 LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-99854] p 96 N87-22237 LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32286 Stability in the relative equilibrium positions of space stations at triangular libration points in the photogravitational three-body problem p 1 A87-32802 LAMINATES Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 LARGE SCALE INTEGRATION SS focused technology: Gateways and NOS's p 117 N87-29165 LARGE SPACE STRUCTURES Fiber-optic monitors for space structures p 11 A87-31505 Control operations in advanced aerospace systems	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 New concepts of deployable truss units for large space structures [AIAA PAPER 87-0868] p 14 A87-33632 On orbit damage assessment for large space structures [AIAA PAPER 87-0870] p 15 A87-33634 Design considerations for a one-kilometer antenna stick [AIAA PAPER 87-0871] p 15 A87-33635 Identification of the zero-g shape of a space beam [AIAA PAPER 87-0872] p 15 A87-33636 Dynamical response to pulse excitations in large space structures [AIAA PAPER 87-07710] p 15 A87-33658 Vibration suppression using a constrained rate-feedback Threshold control strategy for large space structures [AIAA PAPER 87-0741] p 6 A87-33665 System identification of a truss type space structure using the multiple boundary condition test (MBCT)	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module  Flexible system model reduction and control system design based upon actuator and sensor influence functions  An approach to structure/control simultaneous optimization for large flexible spacecraft  p 22 A87-46793  Space Station business  p 59 A87-47726  Robust multivariable control of large space structures using positivity  Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure  p 22 A87-47812  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure  p 60 A87-50033  Construction of positive real compensation for LSS control applied to Large Space Structure model  [AIAA PAPER 87-2238]  p 60 A87-50404  Low-authority control of large space structures by using tendon control system  [AIAA PAPER 87-2249]  The control of linear dampers for large space structures  [AIAA PAPER 87-2251]  Robust eigensystem assignment for flexible structures  [AIAA PAPER 87-2252]  Robust control of a large space antenna  [AIAA PAPER 87-2253]  P 60 A87-50415  Robust control of a large space antenna
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite p 86 A87-50157 LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32286 Stability in the relative equilibrium positions of space stations at triangular libration points in the photogravitational three-body problem p 1 A87-32802 LAMINATES Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 LARGE SCALE INTEGRATION SS focused technology: Gateways and NOS's p 117 N87-29165 LARGE SPACE STRUCTURES Fiber-optic monitors for space structures Control operations in advanced aerospace systems p 54 A87-32117	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-4354 Flexible system model reduction and control system design based upon actuator and sensor influence functions An approach to structure/control simultaneous optimization for large flexible spacecraft p 22 A87-46793 Space Station business p 169 A87-47726 Robust multivariable control of large space structures using positivity p 59 A87-47810 Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 22 A87-47812 Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714 Modeling and control of torsional vibrations in a flexible structure Construction of positive real compensation for LSS control applied to Large Space Structure model [AIAA PAPER 87-2238] p 60 A87-50404 Low-authority control of large space structures by using tendon control system [AIAA PAPER 87-2251] p 60 A87-50413 The control of linear dampers for large space structures [AIAA PAPER 87-2251] p 60 A87-50415 Robust eigensystem assignment for flexible structures [AIAA PAPER 87-2252] p 23 A87-50416 Robust control of a large space antenna [AIAA PAPER 87-2253] p 86 A87-50417 Active damping control design for the COFS Mast Flight
L-SAT Infrared test technique validation on the Olympus satellite  [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite p 86 A87-50157 LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-99854] p 96 N87-22237 LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32286 Stability in the relative equilibrium positions of space stations at triangular libration points in the photogravitational three-body problem p 1 A87-32802 LAMINATES Taylored laminates with null or arbitrary coefficient of thermal expansion LARGE SCALE INTEGRATION SS focused technology: Gateways and NOS's p 117 N87-29165 LARGE SPACE STRUCTURES Fiber-optic monitors for space structures p 11 A87-31505 Control operations in advanced aerospace systems p 54 A87-32117 Space structure vibration modes - How many exist?	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 New concepts of deployable truss units for large space structures [AIAA PAPER 87-0868] p 14 A87-33632 On orbit damage assessment for large space structures [AIAA PAPER 87-0870] p 15 A87-33634 Design considerations for a one-kilometer antenna stick [AIAA PAPER 87-0871] p 15 A87-33635 Identification of the zero-g shape of a space beam [AIAA PAPER 87-0872] p 15 A87-33636 Dynamical response to pulse excitations in large space structures [AIAA PAPER 87-0710] p 15 A87-33658 Vibration suppression using a constrained rate-feedback Threshold control strategy — for large space structures [AIAA PAPER 87-0741] p 6 A87-33665 System identification of a truss type space structure using the multiple boundary condition test (MBCT) method [AIAA PAPER 87-0746] p 16 A87-33670	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-4354  Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301  An approach to structure/control simultaneous optimization for large flexible spacecraft  Space Station business p 169 A87-47786  Robust multivariable control of large space structures using positivity Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714  Modeling and control of torsional vibrations in a flexible structure p 60 A87-50043  Construction of positive real compensation for LSS control applied to Large Space Structure model [AIAA PAPER 87-2238] p 60 A87-50404  Low-authority control of large space structures by using tendon control system  [AIAA PAPER 87-2251] p 60 A87-50413  The control of linear dampers for large space structures  [AIAA PAPER 87-2251] p 60 A87-50415  Robust eigensystem assignment for flexible structures  [AIAA PAPER 87-2252] p 23 A87-50416  Robust control of a large space antenna
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] Modal-survey testing of the Olympus space-craft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite P 86 A87-50157 LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] P 96 N87-22237 LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32286 Stability in the relative equilibrium positions of space stations at triangular libration points in the photogravitational three-body problem p 1 A87-32802 LAMINATES Taylored laminates with null or arbitrary coefficient of thermal expansion LARGE SCALE INTEGRATION S focused technology: Gateways and NOS's p 117 N87-29165 LARGE SPACE STRUCTURES Fiber-optic monitors for space structures p 11 A87-31505 Control operations in advanced aerospace systems p 54 A87-32117 Space structure vibration modes - How many exist? Which ones are important? p 11 A87-31210	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-43354 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 An approach to structure/control simultaneous optimization for large flexible spacecraft  Space Station business p 169 A87-47726 Robust multivariable control of large space structures using positivity Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714 Modeling and control of torsional vibrations in a flexible structure applied to Large Space Structure model [AIAA PAPER 87-2238] p 60 A87-50033 Construction of positive real compensation for LSS control — applied to Large Space Structure model [AIAA PAPER 87-2238] p 60 A87-50404 Low-authority control of large space structures by using tendon control system [AIAA PAPER 87-2249] p 60 A87-50413 The control of linear dampers for large space structures [AIAA PAPER 87-2251] p 60 A87-50415 Robust eigensystem assignment for flexible structures [AIAA PAPER 87-2252] p 23 A87-50415 Robust eigensystem assignment for flexible structures [AIAA PAPER 87-2252] p 23 A87-50415 Active damping control design for the COFS Mast Flight System — Control of Flexible Structures program for NASA
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite p 86 A87-50157 LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-99854] p 96 N87-22237 LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32286 Stability in the relative equilibrium positions of space stations at triangular libration points in the photogravitational three-body problem p 1 A87-32802 LAMINATES Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 LARGE SCALE INTEGRATION SS focused technology: Gateways and NOS's p 117 N87-29165 LARGE SPACE STRUCTURES Fiber-optic monitors for space structures p 11 A87-31505 Control operations in advanced aerospace systems p 54 A87-32117 Space structure vibration modes - How many exist? Which ones are important? p 117 A87-32120 Prediction of random vibrational responses of a large	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-4354 Flexible system model reduction and control system design based upon actuator and sensor influence functions An approach to structure/control simultaneous optimization for large flexible spacecraft p 22 A87-46793 Space Station business p 169 A87-47726 Robust multivariable control of large space structures using positivity p 59 A87-47810 Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 22 A87-47812 Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714 Modeling and control of torsional vibrations in a flexible structure Construction of positive real compensation for LSS control applied to Large Space Structure model [AIAA PAPER 87-2238] p 60 A87-50404 Low-authority control of large space structures by using tendon control system [AIAA PAPER 87-2251] p 60 A87-50413 The control of linear dampers for large space structures [AIAA PAPER 87-2251] p 60 A87-50416 Robust eigensystem assignment for flexible structures [AIAA PAPER 87-2252] p 23 A87-50416 Robust control of a large space antenna [AIAA PAPER 87-2253] p 86 A87-50416 System Control of Flexible Structures program for NASA [AIAA PAPER 87-2331] p 83 A87-50442
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite p 86 A87-50157 LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-98654] p 96 N87-22237 LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32286 Stability in the relative equilibrium positions of space stations at triangular libration points in the photogravitational three-body problem p 1 A87-32802 LAMINATES Taylored laminates with null or arbitrary coefficient of thermal expansion LARGE SCALE INTEGRATION SS focused technology: Gateways and NOS's p 117 N87-29165 LARGE SPACE STRUCTURES Fiber-optic monitors for space structures p 11 A87-31505 Control operations in advanced aerospace systems p 54 A87-32117 Space structure vibration modes - How many exist? Which ones are important? p 11 A87-32120 Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 New concepts of deployable truss units for large space structures [AIAA PAPER 87-0868] p 14 A87-33632 On orbit damage assessment for large space structures [AIAA PAPER 87-0870] p 15 A87-33634 Design considerations for a one-kilometer antenna stick [AIAA PAPER 87-0871] p 15 A87-33635 Identification of the zero-g shape of a space beam [AIAA PAPER 87-0872] p 15 A87-33636 Dynamical response to pulse excitations in large space structures [AIAA PAPER 87-0710] p 15 A87-33658 Vibration suppression using a constrained rate-feedback Threshold control strategy for large space structures [AIAA PAPER 87-0741] p 6 A87-33665 System identification of a truss type space structure using the multiple boundary condition test (MBCT) method [AIAA PAPER 87-0746] p 16 A87-33670 Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE)	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-4354 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 An approach to structure/control simultaneous optimization for large flexible spacecraft  Space Station business p 169 A87-47726 Robust multivariable control of large space structures using positivity p 59 A87-47720 Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 122 A87-47812 Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714 Modeling and control of torsional vibrations in a flexible structure p 60 A87-50033 Construction of positive real compensation for LSS control applied to Large Space Structure model [AIAA PAPER 87-2238] p 60 A87-50404 Low-authority control of large space structures by using tendon control system [AIAA PAPER 87-2249] p 60 A87-50413 The control of linear dampers for large space structures [AIAA PAPER 87-2251] p 60 A87-50415 Robust eigensystem assignment for flexible structures [AIAA PAPER 87-2252] p 23 A87-50416 Robust control of a large space antenna [AIAA PAPER 87-2252] p 23 A87-50416 Robust control of a large space antenna [AIAA PAPER 87-2252] p 23 A87-50416 System Control of Flexible Structures program for NASA [AIAA PAPER 87-2231] p 24 A87-50442 Active vibration control synthesis for the COFS-I - A
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite P86 A87-50157 LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] P96 N87-22237 LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32286 Stability in the relative equilibrium positions of space stations at triangular libration points in the photogravitational three-body problem p 1 A87-32802 LAMINATES Taylored laminates with null or arbitrary coefficient of thermal expansion LARGE SCALE INTEGRATION SS focused technology: Gateways and NOS's p 117 N87-29165 LARGE SPACE STRUCTURES Fiber-optic monitors for space structures p 11 A87-31505 Control operations in advanced aerospace systems p 54 A87-32117 Space structure vibration modes - How many exist? Which ones are important? p 11 A87-32120 Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 New concepts of deployable truss units for large space structures [AIAA PAPER 87-0868] p 14 A87-33632 On orbit damage assessment for large space structures [AIAA PAPER 87-0870] p 15 A87-33634 Design considerations for a one-kilometer antenna stick [AIAA PAPER 87-0871] p 15 A87-33636 [AIAA PAPER 87-0872] p 15 A87-33636 [AIAA PAPER 87-0710] p 15 A87-33636 Dynamical response to pulse excitations in large space structures [AIAA PAPER 87-0710] p 15 A87-33658 Vibration suppression using a constrained rate-feedback Threshold control strategy for large space structures [AIAA PAPER 87-0710] p 6 A87-33656 System identification of a truss type space structure [AIAA PAPER 87-0746] p 6 A87-33660 System identification of a truss type space structure [AIAA PAPER 87-0746] p 16 A87-33670 Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE) structure [AIAA PAPER 87-0895] p 16 A87-33689	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-4354 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 An approach to structure/control simultaneous optimization for large flexible spacecraft  Space Station business p 169 A87-47726 Robust multivariable control of large space structures using positivity p 59 A87-47720 Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 122 A87-47812 Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714 Modeling and control of torsional vibrations in a flexible structure p 60 A87-50033 Construction of positive real compensation for LSS control applied to Large Space Structure model [AIAA PAPER 87-2238] p 60 A87-50404 Low-authority control of large space structures by using tendon control system [AIAA PAPER 87-2249] p 60 A87-50413 The control of linear dampers for large space structures [AIAA PAPER 87-2251] p 60 A87-50415 Robust eigensystem assignment for flexible structures [AIAA PAPER 87-2252] p 23 A87-50416 Robust control of a large space antenna [AIAA PAPER 87-2252] p 23 A87-50416 Robust control of a large space antenna [AIAA PAPER 87-2252] p 23 A87-50416 System Control of Flexible Structures program for NASA [AIAA PAPER 87-2231] p 24 A87-50442 Active vibration control synthesis for the COFS-I - A
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite p 86 A87-50157 LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32286 Stability in the relative equilibrium positions of space stations at triangular libration points in the photogravitational three-body problem p 1 A87-32802 LAMINATES Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 LARGE SCALE INTEGRATION SS focused technology: Gateways and NOS's p 117 N87-29165 LARGE SPACE STRUCTURES Fiber-optic monitors for space structures p 11 A87-31505 Control operations in advanced aerospace systems p 54 A87-32117 Space structure vibration modes - How many exist? Which ones are important? p 11 A87-31220 Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334 Validation of large space structures by ground tests	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 New concepts of deployable truss units for large space structures [AIAA PAPER 87-0868] p 14 A87-33632 On orbit damage assessment for large space structures [AIAA PAPER 87-0870] p 15 A87-33634 Design considerations for a one-kilometer antenna stick [AIAA PAPER 87-0871] p 15 A87-33636 [AIAA PAPER 87-0872] p 15 A87-33636 Dynamical response to pulse excitations in large space structures [AIAA PAPER 87-0710] p 15 A87-33658 Vibration suppression using a constrained rate-feedback Threshold control strategy for large space structures [AIAA PAPER 87-0711] p 6 A87-33656 System identification of a truss type space structures [AIAA PAPER 87-0741] p 6 A87-33665 System identification of a truss type space structures [AIAA PAPER 87-0746] p 16 A87-33660 Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE) structure [AIAA PAPER 87-0895] p 16 A87-33689 Positive position feedback control for large space	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-43354 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 An approach to structure/control simultaneous optimization for large flexible spacecraft p 22 A87-46793 Space Station business p 169 A87-47726 Robust multivariable control of large space structures using positivity p 59 A87-47810 Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces p 22 A87-47812 Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714 Modeling and control of torsional vibrations in a flexible structure applied to Large Space Structure model [AIAA PAPER 87-2238] p 60 A87-50404 Low-authority control of large space structures by using tendon control system [AIAA PAPER 87-2249] p 60 A87-50413 The control of linear dampers for large space structures [AIAA PAPER 87-2251] p 60 A87-50415 Robust eigensystem assignment for flexible structures [AIAA PAPER 87-2252] p 23 A87-50416 Robust control of a large space antenna [AIAA PAPER 87-2253] p 86 A87-50416 Active damping control design for the COFS Mast Flight System Control of Flexible Structures program for NASA [AIAA PAPER 87-2321] p 23 A87-50412 Active vibration control synthesis for the COFS-I - A classical approach Control of Flexible Structures experiment for NASA
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite p 86 A87-50157 LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-98854] p 96 N87-22237 LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32286 Stability in the relative equilibrium positions of space stations at triangular libration points in the photogravitational three-body problem p 1 A87-32802 LAMINATES Taylored laminates with null or arbitrary coefficient of thermal expansion LARGE SCALE INTEGRATION SS focused technology: Gateways and NOS's p 117 N87-29165 LARGE SPACE STRUCTURES Fiber-optic monitors for space structures p 11 A87-31505 Control operations in advanced aerospace systems p 54 A87-32117 Space structure vibration modes - How many exist? Which ones are important? p 11 A87-32120 Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334 Validation of large space structures by ground tests	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 New concepts of deployable truss units for large space structures [AIAA PAPER 87-0868] p 14 A87-33632 On orbit damage assessment for large space structures [AIAA PAPER 87-0870] p 15 A87-33634 Design considerations for a one-kilometer antenna stick [AIAA PAPER 87-0871] p 15 A87-33635 Identification of the zero-g shape of a space beam [AIAA PAPER 87-0872] p 15 A87-33636 Dynamical response to pulse excitations in large space structures [AIAA PAPER 87-0710] p 15 A87-33658 Vibration suppression using a constrained rate-feedback Threshold control strategy for large space structure using the multiple boundary condition test (MBCT) method [AIAA PAPER 87-0746] p 16 A87-33669 Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE) structure [AIAA PAPER 87-0895] p 16 A87-33689 Positive position feedback control for large space	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-43354 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 An approach to structure/control simultaneous optimization for large flexible spacecraft  Space Station business p 169 A87-47726 Robust multivariable control of large space structures using positivity perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48712 Hodeling and control of torsional vibrations in a flexible structure Construction of positive real compensation for LSS control applied to Large Space Structure model [AIAA PAPER 87-2238] p 60 A87-50404 Low-authority control of large space structures by using tendon control system [AIAA PAPER 87-2249] p 60 A87-50413 The control of linear dampers for large space structures [AIAA PAPER 87-2251] p 80 A87-50415 Robust eigensystem assignment for flexible structures [AIAA PAPER 87-2252] p 23 A87-4814 Active damping control design for the COFS Mast Flight System Control of Flexible Structures program for NASA [AIAA PAPER 87-2231] p 23 A87-50417 Active damping control design for the COFS Mast Flight System Control of Flexible Structures program for NASA [AIAA PAPER 87-2321] p 23 A87-50412 Active vibration control synthesis for the COFS I - A classical approach Control of Flexible Structures
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite p 86 A87-50157 LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-93854] p 96 N87-22237 LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32286 Stability in the relative equilibrium positions of space stations at triangular libration points in the photogravitational three-body problem p 1 A87-32802 LAMINATES Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 LARGE SCALE INTEGRATION SS focused technology: Gateways and NOS's p 117 N87-29165 LARGE SPACE STRUCTURES Fiber-optic monitors for space structures p 11 A87-32120 Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334 Validation of large space structures by ground tests p 11 A87-32336 A review of modelling techniques for the open and	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 New concepts of deployable truss units for large space structures [AIAA PAPER 87-0868] p 14 A87-33632 On orbit damage assessment for large space structures [AIAA PAPER 87-0870] p 15 A87-33634 Design considerations for a one-kilometer antenna stick [AIAA PAPER 87-0871] p 15 A87-33636 [AIAA PAPER 87-0872] p 15 A87-33636 Dynamical response to pulse excitations in large space structures [AIAA PAPER 87-0710] p 15 A87-33636 Ubration suppression using a constrained rate-feedback Threshold control strategy for large space structures [AIAA PAPER 87-0711] p 15 A87-33656 System identification of a truss type space structures [AIAA PAPER 87-0741] p 6 A87-33665 System identification of a truss type space structure [AIAA PAPER 87-0746] p 16 A87-33660 Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE) structure [AIAA PAPER 87-0895] p 16 A87-33689 Positive position feedback control for large space structures [AIAA PAPER 87-0902] p 17 A87-33711	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-43354 Flexible system model reduction and control system design based upon actuator and sensor influence functions and approach to structure/control simultaneous optimization for large flexible spacecraft  Space Station business p 169 A87-47726 Robust multivariable control of large space structures using positivity p 59 A87-47726 Robust multivariable control of large space structures using positivity Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-47814 Modeling and control of torsional vibrations in a flexible structure p 60 A87-50033 Construction of positive real compensation for LSS control — applied to Large Space Structure model [AIAA PAPER 87-2238] p 60 A87-50404 Low-authority control of large space structures by using tendon control system [AIAA PAPER 87-2249] p 60 A87-50413 The control of linear dampers for large space structures [AIAA PAPER 87-2251] p 80 A87-50415 Robust eigensystem assignment for flexible structures [AIAA PAPER 87-2252] p 23 A87-50416 Robust control of a large space antenna [AIAA PAPER 87-2253] p 86 A87-50415 System — Control of Flexible Structures program for NASA [AIAA PAPER 87-231] p 23 A87-50442 Active vibration control synthesis for the COFS-I - A classical approach — Control of Flexible Structures experiment for NASA [AIAA PAPER 87-2322] p 23 A87-50442
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32237 LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32280 Stability in the relative equilibrium positions of space stations at triangular libration points in the photogravitational three-body problem p 1 A87-32802 LAMINATES Taylorde laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 LARGE SCALE INTEGRATION S focused technology: Gateways and NOS's p 117 N87-29165 LARGE SPACE STRUCTURES Fiber-optic monitors for space structures p 11 A87-31505 Control operations in advanced aerospace systems p 54 A87-32117 Space structure vibration modes - How many exist? Which ones are important? p 11 A87-32120 Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32336 A review of modelling techniques for the open and closed-loop dynamics of large space systems	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 New concepts of deployable truss units for large space structures [AIAA PAPER 87-0868] p 14 A87-33632 On orbit damage assessment for large space structures [AIAA PAPER 87-0870] p 15 A87-33634 Design considerations for a one-kilometer antenna stick [AIAA PAPER 87-0871] p 15 A87-33636 [AIAA PAPER 87-0872] p 15 A87-33636 Dynamical response to pulse excitations in large space structures [AIAA PAPER 87-0710] p 15 A87-33658 Vibration suppression using a constrained rate-feedback Threshold control strategy for large space structures [AIAA PAPER 87-0711] p 6 A87-33656 System identification of a truss type space structures [AIAA PAPER 87-0741] p 6 A87-33665 System identification of a truss type space structures [AIAA PAPER 87-0741] p 16 A87-33660 Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE) structure [AIAA PAPER 87-0895] p 16 A87-33689 Positive position feedback control for large space structures [AIAA PAPER 87-0895] p 16 A87-33689 Positive position feedback control for large space structures [AIAA PAPER 87-0895] p 16 A87-33689 Positive position feedback control for large space structures [AIAA PAPER 87-0895] p 16 A87-33689 Positive position feedback control for large space structures [AIAA PAPER 87-0895] p 16 A87-33689	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-43354 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 An approach to structure/control simultaneous optimization for large flexible spacecraft  Space Station business p 169 A87-47726 Robust multivariable control of large space structures using positivity p 59 A87-47810 Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714 Modeling and control of torsional vibrations in a flexible structure p 60 A87-50043 Construction of positive real compensation for LSS control applied to Large Space Structure model [AIAA PAPER 87-2238] p 60 A87-50404 Low-authority control of large space structures by using tendon control system [AIAA PAPER 87-2249] p 60 A87-50413 The control of linear dampers for large space structures [AIAA PAPER 87-2251] p 80 A87-50415 Robust eigensystem assignment for flexible structures [AIAA PAPER 87-2252] p 23 A87-50415 Robust control of a large space antenna [AIAA PAPER 87-2252] p 23 A87-50415 Active damping control design for the COFS Mast Flight System Control of Flexible Structures program for NASA [AIAA PAPER 87-2321] p 24 A87-50412 Active vibration control synthesis for the COFS I - A classical approach Control of Flexible Structures experiment for NASA [AIAA PAPER 87-2322] p 23 A87-50442 Suboptimal feedback vibration control of a beam with
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] p 150 A87-38728 Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite p 86 A87-50157 LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32286 Stability in the relative equilibrium positions of space stations at triangular libration points in the photogravitational three-body problem p 1 A87-32802 LAMINATES Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 LARGE SCALE INTEGRATION SS focused technology: Gateways and NOS's p 117 N87-29165 LARGE SPACE STRUCTURES Fiber-optic monitors for space structures p 11 A87-31505 Control operations in advanced aerospace systems p 54 A87-32117 Space structure vibration modes - How many exist? Which ones are important? p 11 A87-31220 Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32336 A review of modelling techniques for the open and closed-loop dynamics of large space systems p 12 A87-32337	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 New concepts of deployable truss units for large space structures [AIAA PAPER 87-0868] p 14 A87-33632 On orbit damage assessment for large space structures [AIAA PAPER 87-0870] p 15 A87-33634 Design considerations for a one-kilometer antenna stick [AIAA PAPER 87-0871] p 15 A87-33635 Identification of the zero-g shape of a space beam [AIAA PAPER 87-0872] p 15 A87-33636 Dynamical response to pulse excitations in large space structures [AIAA PAPER 87-0710] p 15 A87-33636 Vibration suppression using a constrained rate-feedback Threshold control strategy for large space structure [AIAA PAPER 87-0741] p 6 A87-33655 System identification of a truss type space structures [AIAA PAPER 87-0746] p 16 A87-33660 Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE) structure [AIAA PAPER 87-0895] p 16 A87-33689 Positive position feedback control for large space structures [AIAA PAPER 87-0902] p 17 A87-33711 Spillover stabilization and decentralized modal control of large space structures	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-43354 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 An approach to structure/control simultaneous optimization for large flexible spacecraft  Space Station business p 169 A87-47726 Robust multivariable control of large space structures using positivity Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714 Modeling and control of torsional vibrations in a flexible structure applied to Large Space Structure model [AIAA PAPER 87-2238] p 60 A87-50033 Construction of positive real compensation for LSS control — applied to Large Space Structure model [AIAA PAPER 87-2238] p 60 A87-50404 Low-authority control of large space structures by using tendon control system [AIAA PAPER 87-2249] p 60 A87-50413 The control of linear dampers for large space structures [AIAA PAPER 87-2251] p 60 A87-50415 Robust eigensystem assignment for flexible structures [AIAA PAPER 87-2252] p 23 A87-50415 Active damping control design for the COFS Mast Flight System — Control of a large space antenna [AIAA PAPER 87-2321] p 23 A87-50416 Active vibration control synthesis for the COFS Mast Flight System — Control of Flexible Structures program for NASA [AIAA PAPER 87-2321] p 23 A87-50442 Active vibration control synthesis for the COFS Lea Active vibration control of Flexible Structures experiment for NASA [AIAA PAPER 87-2321] p 23 A87-50443 Suboptimal feedback vibration control of a beam with a proof-mass actuator — large space structures
L-SAT Infrared test technique validation on the Olympus satellite [SAE PAPER 860939] Modal-survey testing of the Olympus spacecraft p 152 A87-42266 Design of a beacon receiving system for the Olympus satellite LABORATORIES A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32237 LAGRANGIAN EQUILIBRIUM POINTS Space colonization - T minus 20 (years) and holding p 166 A87-32280 Stability in the relative equilibrium positions of space stations at triangular libration points in the photogravitational three-body problem p 1 A87-32802 LAMINATES Taylorde laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 LARGE SCALE INTEGRATION S focused technology: Gateways and NOS's p 117 N87-29165 LARGE SPACE STRUCTURES Fiber-optic monitors for space structures p 11 A87-31505 Control operations in advanced aerospace systems p 54 A87-32117 Space structure vibration modes - How many exist? Which ones are important? p 11 A87-32120 Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32336 A review of modelling techniques for the open and closed-loop dynamics of large space systems	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564 A Lanczos eigenvalue method on a parallel computer for large complex space structure free vibration analysis [AIAA PAPER 87-0725] p 13 A87-33565 Simultaneous structure/control optimization of large flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610 Integrated structural electromagnetic optimization of large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 New concepts of deployable truss units for large space structures [AIAA PAPER 87-0868] p 14 A87-33632 On orbit damage assessment for large space structures [AIAA PAPER 87-0870] p 15 A87-33634 Design considerations for a one-kilometer antenna stick [AIAA PAPER 87-0871] p 15 A87-33636 [AIAA PAPER 87-0872] p 15 A87-33636 Dynamical response to pulse excitations in large space structures [AIAA PAPER 87-0710] p 15 A87-33658 Vibration suppression using a constrained rate-feedback Threshold control strategy for large space structures [AIAA PAPER 87-0711] p 6 A87-33656 System identification of a truss type space structures [AIAA PAPER 87-0741] p 6 A87-33665 System identification of a truss type space structures [AIAA PAPER 87-0741] p 16 A87-33660 Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE) structure [AIAA PAPER 87-0895] p 16 A87-33689 Positive position feedback control for large space structures [AIAA PAPER 87-0895] p 16 A87-33689 Positive position feedback control for large space structures [AIAA PAPER 87-0895] p 16 A87-33689 Positive position feedback control for large space structures [AIAA PAPER 87-0895] p 16 A87-33689 Positive position feedback control for large space structures [AIAA PAPER 87-0895] p 16 A87-33689	A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module p 125 A87-43354 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 An approach to structure/control simultaneous optimization for large flexible spacecraft  Space Station business p 169 A87-47726 Robust multivariable control of large space structures using positivity Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and circulatory forces Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714 Modeling and control of torsional vibrations in a flexible structure p 26 A87-50033 Construction of positive real compensation for LSS control — applied to Large Space Structure model [AIAA PAPER 87-2238] p 60 A87-50404 Low-authority control of large space structures by using tendon control system [AIAA PAPER 87-2249] p 60 A87-50413 The control of linear dampers for large space structures [AIAA PAPER 87-2251] p 60 A87-50413 Robust eigensystem assignment for flexible structures [AIAA PAPER 87-2252] p 23 A87-50415 Robust eigensystem assignment for flexible structures [AIAA PAPER 87-2252] p 23 A87-50415 Active damping control design for the COFS Mast Flight System — Control of Flexible Structures program for NASA [AIAA PAPER 87-2321] p 23 A87-50442 Active vibration control synthesis for the COFS-I - A classical approach — Control of Flexible Structures experiment for NASA [AIAA PAPER 87-2322] p 23 A87-50444 Active vibration control synthesis for the COFS-I - A classical approach — Control of Flexible Structures experiment for NASA [AIAA PAPER 87-2322] p 23 A87-50444 Active vibration control synthesis for the COFS-I - A classical approach — Control of Flexible Structures experiment for NASA [AIAA PAPER 87-2322] p 23 A87-50444 Active vibration control synthesis for the coft-SI - A classical approach — Control of Flexible Structures experiment for NASA [AIAA P

Output feedback vs optimal control

[AIAA PAPER 87-0904]

Design consideration of mechanical and deployment

properties of a coilable lattice mast p 12 A87-32340

Square root state estimator for large space structures
[AIAA PAPER 87-2389] p 24 A87-50473 An analytical and experimental investigation of output
feedback vs. linear quadratic regulator for large space
structures [AIAA PAPER 87-2390] p 61 A87-50474
[AIAA PAPER 87-2390] p 61 A87-50474 Comparison of different attitude control schemes for
large communications satellites
[AIAA PAPER 87-2391] p 61 A87-50475 Adaptive momentum management for the dual keel
Space Station
[AIAA PAPER 87-2596] p 62 A87-50558
Space Station - All change? p 154 A87-50792 Global treatment of energy dissipation effects for
multibody satellites p 62 A87-51610
Development of metal matrix composites in R & D
Institute of Metals & Composites for Future Industries p 107 A87-51772
Development of full scale deployable CFRP truss for
space structure p 25 A87-51793
Equations of motion for maneuvering flexible spacecraft p 63 A87-52965
Identification of large space structures - A factorization
approach p 25 A87-52966
Model reference adaptive control for large structural systems p 63 A87-52973
Effects of space plasma discharge on the performance
of large antenna structures in low Earth orbit [NASA-TM-89118] p 86 N87-20339
[NASA-TM-89118] p 86 N87-20339 Dynamic and thermal effects in very large space
structures p 25 N87-20347
Studies in nonlinear structural dynamics: Chaotic behavior and poynting effect p 26 N87-20348
Large space antennas: A systems analysis case
history
[NASA-TM-89072] p 26 N87-20352 Mechanical Qualification of Large Flexible Spacecraft
Structures
[AD-A175529] p 26 N87-20355
Future trends in spacecraft design and qualification p 2 N87-20356
Recent developments and future trends in structural
dynamic design verification and qualification of large
flexible spacecraft p 156 N87-20357  Dynamic modeling and optimal control design for large
flexible space structures p 26 N87-20358
Structural qualification of large spacecraft
p 26 N87-20361 Effect of modal damping in modal synthesis of spacecraft
Active structural controllers emulating structural
Active structural controllers emulating structural elements by ICUs p 27 N87-20367
Active structural controllers emulating structural elements by ICUs p 27 N87-20367 Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20368
Active structural controllers emulating structural elements by ICUs p 27 N87-20367 Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20368 Influence co-efficient testing as a substitute for modal
Active structural controllers emulating structural elements by ICUs p 27 N87-20367 Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures
Active structural controllers emulating structural elements by ICUs p 27 N87-20367 Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures p 27 N87-20369 Benefits of passive damping as applied to active control
Active structural controllers emulating structural elements by ICUs p 27 N87-20367 Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures p 27 N87-20369 Benefits of passive damping as applied to active control of large space structures p 63 N87-20371
Active structural controllers emulating structural elements by ICUs p 27 N87-20367 Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures p 27 N87-20369 Benefits of passive damping as applied to active control of large space structures p 63 N87-20371 Development of precision structural joints for large space structures p 28 N87-20374
Active structural controllers emulating structural elements by ICUs p 27 N87-20367 Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures  p 27 N87-20369 Benefits of passive damping as applied to active control of large space structures p 63 N87-20371 Development of precision structural joints for large space structures p 28 N87-20374 Solar array flight experiment/dynamic augmentation
Active structural controllers emulating structural elements by ICUs p 27 N87-20367 Space-rart qualification using advanced vibration and modal testing techniques p 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures p 27 N87-20369 Benefits of passive damping as applied to active control of large space structures p 63 N87-20371 Development of precision structural joints for large space structures p 28 N87-20374 Solar array flight experiment/dynamic augmentation experiment
Active structural controllers emulating structural elements by ICUs p 27 N87-20367 Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures p 27 N87-20369 Benefits of passive damping as applied to active control of large space structures p 63 N87-20371 Development of precision structural joints for large space structures p 28 N87-20374 Solar array flight experiment/dynamic augmentation experiment [NASA-TP-2690] p 63 N87-20380 Modeling of joints for the dynamic analysis of truss
Active structural controllers emulating structural elements by ICUs Spacecraft qualification using advanced vibration and modal testing techniques Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20369 Benefits of passive damping as applied to active control of large space structures  P 28 N87-20371 Development of precision structural joints for large space structures  P 28 N87-20374 Solar array flight experiment/dynamic augmentation experiment [NASA-TP-2690]  P 63 N87-20380 Modeling of joints for the dynamic analysis of truss structures
Active structural controllers emulating structural elements by ICUs p 27 N87-20367 Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures p 27 N87-20369 Benefits of passive damping as applied to active control of large space structures p 63 N87-20371 Development of precision structural joints for large space structures p 28 N87-20374 Solar array flight experiment/dynamic augmentation experiment [NASA-TP-2690] p 63 N87-20380 Modeling of joints for the dynamic analysis of truss
Active structural controllers emulating structural elements by ICUs Spacecraft qualification using advanced vibration and modal testing techniques Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20369 Benefits of passive damping as applied to active control of large space structures  P 28 N87-20371 Development of precision structural joints for large space structures  P 28 N87-20374 Solar array flight experiment/dynamic augmentation experiment [NASA-TP-2690] P 63 N87-20380 Modeling of joints for the dynamic analysis of truss structures [NASA-TP-2661] Space station structures and dynamics test program [NASA-TP-2710] P 28 N87-20568
Active structural controllers emulating structural elements by ICUs Spacecraft qualification using advanced vibration and modal testing techniques Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20369 Benefits of passive damping as applied to active control of large space structures  P 28 N87-20379 Development of precision structural joints for large space structures  P 28 N87-20374 Solar array flight experiment/dynamic augmentation experiment [NASA-TP-2690] Modeling of joints for the dynamic analysis of truss structures [NASA-TP-2661] Space station structures and dynamics test program [NASA-TP-2710] The Shock and Vibration Bulletin. Part 1: Welcome,
Active structural controllers emulating structural elements by ICUs Spacecraft qualification using advanced vibration and modal testing techniques Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20369 Benefits of passive damping as applied to active control of large space structures  P 28 N87-20371 Development of precision structural joints for large space structures  P 28 N87-20374 Solar array flight experiment/dynamic augmentation experiment [NASA-TP-2690] P 63 N87-20380 Modeling of joints for the dynamic analysis of truss structures [NASA-TP-2661] P 28 N87-20567 Space station structures and dynamics test program [NASA-TP-2710] P 28 N87-20568 The Shock and Vibration Bulletin. Part 1: Welcome, Invited Papers, Shipboard Shock, Blast and Ground Shock, Shock Testing and Analysis
Active structural controllers emulating structural elements by ICUs Spacecraft qualification using advanced vibration and modal testing techniques Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20369 Benefits of passive damping as applied to active control of large space structures  P 28 N87-20371 Development of precision structural joints for large space structures  P 28 N87-20374 Solar array flight experiment/dynamic augmentation experiment  [NASA-TP-2690]  Modeling of joints for the dynamic analysis of truss structures  [NASA-TP-2661]  Space station structures and dynamics test program [NASA-TP-2710]  P 28 N87-20568 The Shock and Vibration Bulletin. Part 1: Welcome, Invited Papers, Shipboard Shock, Blast and Ground Shock, Shock Testing and Analysis  [AD-A175224]  P 29 N87-20574
Active structural controllers emulating structural elements by ICUs Spacecraft qualification using advanced vibration and modal testing techniques Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20369 Benefits of passive damping as applied to active control of large space structures  P 28 N87-20371 Development of precision structural joints for large space structures  P 28 N87-20374 Solar array flight experiment/dynamic augmentation experiment  [NASA-TP-2690]  Modeling of joints for the dynamic analysis of truss structures  [NASA-TP-2661]  Space station structures and dynamics test program p 28 N87-20567 Space station structures and dynamics test program p 28 N87-20568  The Shock and Vibration Bulletin. Part 1: Welcome, Invited Papers, Shipboard Shock, Blast and Ground Shock, Shock Testing and Analysis  [AD-A175224]  P 29 N87-20574  Air Force basic research in dynamics and control of
Active structural controllers emulating structural elements by ICUs Spacecraft qualification using advanced vibration and modal testing techniques Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20369 Benefits of passive damping as applied to active control of large space structures  P 27 N87-20369 Benefits of passive damping as applied to active control of large space structures  P 28 N87-20371 Development of precision structural joints for large space structures  Solar array flight experiment/dynamic augmentation experiment [NASA-TP-2601] P 63 N87-20380 Modeling of joints for the dynamic analysis of truss structures [NASA-TP-2661] Space station structures and dynamics test program [NASA-TP-2710] P 28 N87-20567 The Shock and Vibration Bulletin. Part 1: Welcome, Invited Papers, Shipboard Shock, Blast and Ground Shock, Shock Testing and Analysis  [AD-A175224] P 29 N87-20574 Air Force basic research in dynamics and control of large space structures  P 63 N87-20575 Modal test and analysis: Multiple tests concept for
Active structural controllers emulating structural elements by ICUs Spacecraft qualification using advanced vibration and modal testing techniques Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20369 Benefits of passive damping as applied to active control of large space structures  P 28 N87-20371 Development of precision structural joints for large space structures  P 28 N87-20374 Solar array flight experiment/dynamic augmentation experiment [NASA-TP-2690] Modeling of joints for the dynamic analysis of truss structures [NASA-TP-2661] Space station structures and dynamics test program [NASA-TP-2710] The Shock and Vibration Bulletin. Part 1: Welcome, Invited Papers, Shipboard Shock, Blast and Ground Shock, Shock Testing and Analysis [AD-A175224]  P 29 N87-20574 Air Force basic research in dynamics and control of large space structures tructure mathematical
Active structural controllers emulating structural elements by ICUs Spacecraft qualification using advanced vibration and modal testing techniques Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20369 Benefits of passive damping as applied to active control of large space structures  P 28 N87-20371 Development of precision structural joints for large space structures  P 28 N87-20374 Solar array flight experiment/dynamic augmentation experiment [NASA-TP-2690] P 63 N87-20380 Modeling of joints for the dynamic analysis of truss structures [NASA-TP-2661] P 28 N87-20567 Space station structures and dynamics test program [NASA-TP-2710] P 28 N87-20568 The Shock and Vibration Bulletin. Part 1: Welcome, Invited Papers, Shipboard Shock, Blast and Ground Shock, Shock Testing and Analysis [AD-A175224] P 29 N87-20574 Air Force basic research in dynamics and control of large space structures  P 8 N87-20577 Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models P 8 N87-20581
Active structural controllers emulating structural elements by ICUs Spacecraft qualification using advanced vibration and modal testing techniques Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20369 Benefits of passive damping as applied to active control of large space structures  P 28 N87-20374 Development of precision structural joints for large space structures  P 28 N87-20374 Solar array flight experiment/dynamic augmentation experiment [NASA-TP-2690] Modeling of joints for the dynamic analysis of truss structures [NASA-TP-2661] Space station structures and dynamics test program [NASA-TP-2710] P 28 N87-20568 The Shock and Vibration Bulletin. Part 1: Welcome, Invited Papers, Shipboard Shock, Blast and Ground Shock, Shock Testing and Analysis [AD-A175224] P 29 N87-20574 Air Force basic research in dynamics and control of large space structures  Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models P 8 N87-20581 Analysis of on-orbit thermal characteristics of the
Active structural controllers emulating structural elements by ICUs Spacecraft qualification using advanced vibration and modal testing techniques Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20369 Benefits of passive damping as applied to active control of large space structures  P 28 N87-20371 Development of precision structural joints for large space structures  P 28 N87-20374 Solar array flight experiment/dynamic augmentation experiment [NASA-TP-2690] P 63 N87-20380 Modeling of joints for the dynamic analysis of truss structures [NASA-TP-2661] Space station structures and dynamics test program [NASA-TP-2710] The Shock and Vibration Bulletin. Part 1: Welcome, Invited Papers, Shipboard Shock, Blast and Ground Shock, Shock Testing and Analysis [AD-A175224] P 29 N87-20574 Air Force basic research in dynamics and control of large space structures  P 8 N87-20581 Analysis of on-orbit thermal characteristics of the 15-meter hoop/column antenna [NASA-TM-89137] P 45 N87-21021
Active structural controllers emulating structural elements by ICUs Spacecraft qualification using advanced vibration and modal testing techniques Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20369 Benefits of passive damping as applied to active control of large space structures  P 28 N87-20374 Development of precision structural joints for large space structures  P 28 N87-20374 Solar array flight experiment/dynamic augmentation experiment [NASA-TP-2690] Modeling of joints for the dynamic analysis of truss structures [NASA-TP-2661] Space station structures and dynamics test program [NASA-TP-2710] P 28 N87-20568 The Shock and Vibration Bulletin. Part 1: Welcome, Invited Papers, Shipboard Shock, Blast and Ground Shock, Shock Testing and Analysis [AD-A175224] P 29 N87-20574 Air Force basic research in dynamics and control of large space structures  Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models P 8 N87-20581 Analysis of on-orbit thermal characteristics of the
Active structural controllers emulating structural elements by ICUs Spacecraft qualification using advanced vibration and modal testing techniques Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20369 Benefits of passive damping as applied to active control of large space structures  P 28 N87-20371 Development of precision structural joints for large space structures  P 28 N87-20374 Solar array flight experiment/dynamic augmentation experiment [NASA-TP-2690] P 63 N87-20380 Modelling of joints for the dynamic analysis of truss structures [NASA-TP-2661] P 28 N87-20567 Space station structures and dynamics test program [NASA-TP-2710] P 28 N87-20568 The Shock and Vibration Bulletin. Part 1: Welcome, Invited Papers, Shipboard Shock, Blast and Ground Shock, Shock Testing and Analysis [AD-A175224] P 29 N87-20577 Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models  P 8 N87-20581 Analysis of on-orbit thermal characteristics of the 15-meter hoop/column antenna [NASA-TM-89137] P 5 N87-20511 Measurement apparatus and procedure for the determination of surface emissivities  NASA-CASE-LAR-13455-1] P 29 N87-21206
Active structural controllers emulating structural elements by ICUs Spacecraft qualification using advanced vibration and modal testing techniques Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20369 Benefits of passive damping as applied to active control of large space structures  P 28 N87-20371 Development of precision structural joints for large space structures  P 28 N87-20374 Solar array flight experiment/dynamic augmentation experiment [NASA-TP-2690] P 63 N87-20380 Modeling of joints for the dynamic analysis of truss structures [NASA-TP-2661] P 28 N87-20567 Space station structures and dynamics test program (NASA-TP-2710) P 28 N87-20567 The Shock and Vibration Bulletin. Part 1: Welcome, Invited Papers, Shipboard Shock, Blast and Ground Shock, Shock Testing and Analysis [AD-A175224] P 29 N87-20574 Air Force basic research in dynamics and control of large space structures  P 63 N87-20577 Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models P 8 N87-20581 Analysis of on-orbit thermal characteristics of the 15-meter hoop/column antenna [NASA-TM-99137] P 45 N87-21021 Measurement apparatus and procedure for the determination of surface emissivities [NASA-CSE-LAR-13455-1] P 29 N87-21206
Active structural controllers emulating structural elements by ICUs Spacecraft qualification using advanced vibration and modal testing techniques Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20369 Benefits of passive damping as applied to active control of large space structures  P 28 N87-20371 Development of precision structural joints for large space structures  P 28 N87-20374 Solar array flight experiment/dynamic augmentation experiment [NASA-TP-2690] P 63 N87-20380 Modeling of joints for the dynamic analysis of truss structures [NASA-TP-2661] P 28 N87-20568 The Shock and Vibration Bulletin. Part 1: Welcome, Invited Papers, Shipboard Shock, Blast and Ground Shock, Shock Testing and Analysis [AD-A175224] P 29 N87-20574 Air Force basic research in dynamics and control of large space structures  P 8 N87-20577 Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models  P 8 N87-20581 Analysis of on-orbit thermal characteristics of the 15-meter hoop/column antenna [NASA-TM-89137] P 45 N87-21021 Measurement apparatus and procedure for the determination of surface emissivities [NASA-CASE-LAR-13455-1] Comparison of wave-mode coordinate and pulse summation methods [AD-A177795] P 30 N87-21992
Active structural controllers emulating structural elements by ICUs Spacecraft qualification using advanced vibration and modal testing techniques Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20369 Benefits of passive damping as applied to active control of large space structures  P 28 N87-20371 Development of precision structural joints for large space structures  P 28 N87-20374 Solar array flight experiment/dynamic augmentation experiment [NASA-TP-2690] P 63 N87-20380 Modeling of joints for the dynamic analysis of truss structures [NASA-TP-2661] P 28 N87-20567 Space station structures and dynamics test program [NASA-TP-2710] P 28 N87-20567 The Shock and Vibration Bulletin. Part 1: Welcome, Invited Papers, Shipboard Shock, Blast and Ground Shock, Shock Testing and Analysis [AD-A175224] P 29 N87-20574 Air Force basic research in dynamics and control of large space structures  P 8 N87-20577 Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models  P 8 N87-20581 Analysis of on-orbit thermal characteristics of the 15-meter hoop/column antenna [NASA-TM-89137] P 45 N87-20581 Measurement apparatus and procedure for the determination of surface emissivities [NASA-CSE-LAR-13455-1] P 29 N87-21208 Comparison of wave-mode coordinate and pulse summation methods [AD-A177795] P 30 N87-21992 Structural concepts for large solar concentrators
Active structural controllers emulating structural elements by ICUs Spacecraft qualification using advanced vibration and modal testing techniques Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20369 Benefits of passive damping as applied to active control flarge space structures  P 28 N87-20371 Development of precision structural joints for large space structures  P 28 N87-20374 Solar array flight experiment/dynamic augmentation experiment  [NASA-TP-2690]  P 63 N87-20380 Modeling of joints for the dynamic analysis of truss structures  [NASA-TP-2661]  Space station structures and dynamics test program  [NASA-TP-2710]  The Shock and Vibration Bulletin. Part 1: Welcome, Invited Papers, Shipboard Shock, Blast and Ground Shock, Shock Testing and Analysis  [AD-A175224]  Air Force basic research in dynamics and control of large space structures  P 8 N87-20577  Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models  Analysis of on-orbit thermal characteristics of the 15-meter hoop/column antenna  [NASA-TM-89137]  Measurement apparatus and procedure for the determination of surface emissivities  [NASA-CASE-LAR-13455-1]  C Omparison of wave-mode coordinate and pulse summation methods  [AD-A177795]  P 9 N87-21994
Active structural controllers emulating structural elements by ICUs Spacecraft qualification using advanced vibration and modal testing techniques Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20369 Benefits of passive damping as applied to active control of large space structures  P 28 N87-20371 Development of precision structural joints for large space structures  P 28 N87-20374 Solar array flight experiment/dynamic augmentation experiment [NASA-TP-2690] P 63 N87-20380 Modeling of joints for the dynamic analysis of truss structures [NASA-TP-2661] P 28 N87-20567 Space station structures and dynamics test program [NASA-TP-2710] P 28 N87-20567 The Shock and Vibration Bulletin. Part 1: Welcome, Invited Papers, Shipboard Shock, Blast and Ground Shock, Shock Testing and Analysis [AD-A175224] P 29 N87-20574 Air Force basic research in dynamics and control of large space structures  P 8 N87-20577 Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models  P 8 N87-20581 Analysis of on-orbit thermal characteristics of the 15-meter hoop/column antenna [NASA-TM-89137] P 45 N87-21021 Measurement apparatus and procedure for the determination of surface emissivities [NASA-CSE-LAR-13455-1] P 29 N87-21080 Comparison of wave-mode coordinate and pulse summation methods [NASA-CR-4075] P 30 N87-21994 Wave propagation in transversely isotropic continuum models of LSS (Large Space Structure)
Active structural controllers emulating structural elements by ICUs Spacecraft qualification using advanced vibration and modal testing techniques Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20369 Benefits of passive damping as applied to active control of large space structures  P 28 N87-20371 Development of precision structural joints for large space structures Solar array flight experiment/dynamic augmentation experiment [NASA-TP-2601] Space station structures and dynamic analysis of truss structures [NASA-TP-2661] Space station structures and dynamics test program (NASA-TP-2710) P 28 N87-20567 Space station structures and dynamics test program (NASA-TP-2710) P 28 N87-20568 The Shock and Vibration Bulletin. Part 1: Welcome, Invited Papers, Shipboard Shock, Blast and Ground Shock, Shock Testing and Analysis [AD-A175224] P 29 N87-20574 Air Force basic research in dynamics and control of large space structure mathematical models Analysis of on-orbit thermal characteristics of the 15-meter hoop/column antenna [NASA-TM-89137] P 45 N87-2051 Measurement apparatus and procedure for the determination of surface emissivities [NASA-CASE-LAR-13455-1] P 29 N87-21206 Comparison of wave-mode coordinate and pulse summation methods [AD-A177775] P 30 N87-22561 Wave propagation in transversely isotropic continuum models of LSS (Large Space Structures) [AD-A177271] P 30 N87-22256
Active structural controllers emulating structural elements by ICUs Spacecraft qualification using advanced vibration and modal testing techniques Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20369 Benefits of passive damping as applied to active control of large space structures  P 28 N87-20374 Development of precision structural joints for large space structures  P 28 N87-20374 Solar array flight experiment/dynamic augmentation experiment [NASA-TP-2690] P 63 N87-20380 Modeling of joints for the dynamic analysis of truss structures [NASA-TP-2661] P 28 N87-20567 Space station structures and dynamics test program [NASA-TP-2710] The Shock and Vibration Bulletin. Part 1: Welcome, Invited Papers, Shipboard Shock, Blast and Ground Shock, Shock Testing and Analysis [AD-A175224] P 29 N87-20574 Air Force basic research in dynamics and control of large space structures  Analysis of on-orbit thermal characteristics of the 15-meter hoop/column antenna [NASA-TM-89137] Measurement apparatus and procedure for the determination of surface emissivities [NASA-CR-4075] P 29 N87-21206 Comparison of wave-mode coordinate and pulse surmation methods [AD-A177271] P 30 N87-22256 N87-22256 Structural concepts for large solar concentrators [NASA-CR-4075] P 30 N87-22256 Structural concepts for large solar concentrators [NASA-CR-4075] P 30 N87-22256 Structural concepts for large solar concentrators [NASA-CR-4075] P 30 N87-22256 Structural concepts for large solar concentrators [NASA-CR-4075] P 30 N87-22256
Active structural controllers emulating structural elements by ICUs Spacecraft qualification using advanced vibration and modal testing techniques Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20368 Influence co-efficient testing as a substitute for modal survey testing of large space structures  P 27 N87-20369 Benefits of passive damping as applied to active control of large space structures  P 28 N87-20371 Development of precision structural joints for large space structures Solar array flight experiment/dynamic augmentation experiment [NASA-TP-2601] Space station structures and dynamic analysis of truss structures [NASA-TP-2661] Space station structures and dynamics test program (NASA-TP-2710) P 28 N87-20567 Space station structures and dynamics test program (NASA-TP-2710) P 28 N87-20568 The Shock and Vibration Bulletin. Part 1: Welcome, Invited Papers, Shipboard Shock, Blast and Ground Shock, Shock Testing and Analysis [AD-A175224] P 29 N87-20574 Air Force basic research in dynamics and control of large space structure mathematical models Analysis of on-orbit thermal characteristics of the 15-meter hoop/column antenna [NASA-TM-89137] P 45 N87-2051 Measurement apparatus and procedure for the determination of surface emissivities [NASA-CASE-LAR-13455-1] P 29 N87-21206 Comparison of wave-mode coordinate and pulse summation methods [AD-A177775] P 30 N87-22561 Wave propagation in transversely isotropic continuum models of LSS (Large Space Structures) [AD-A177271] P 30 N87-22256

tests

```
Large space structures ground experiment checkout
                                                                Design,
                                                                          development and fabrication of
                                     p 30 N87-22704
                                                               deployable/retractable truss beam model for large space
   Identification
                  of
                      large
                             space
                                        structures:
                                                               structures application
                                      p 31 N87-22705
  state-of-practice report
                                                              [NASA-CR-178287]
                                                                                                   p 35 N87-25349
   Considerations in the design and development of a
                                                                Some problems in the control of large space
 space station scale model
                                       p 9 N87-22711
   Verification of large beam-type space structures
                                                                                                   p 70 N87-25350
                                                              [AD-A179989]
                                      p 31 N87-22712
                                                                Suboptimal control of large flexible space structures
   Verification of flexible structures by ground test
                                                                periencing rotational dynamics nonlinearities
                                     p 31 N87-22713
                                                                                                   p 71 N87-25352
                                                              [AD-A180606]
   Optimum mix of passive and active control of space ructures p 65 N87-22714
                                                                The effects of structural perturbations on decoupled
 structures
                                                              control --- spacecraft
                                                                                                  p 35 N87-25359
   One Controller at a Time (1-CAT): A mimo design
                                                              Deployable geodesic truss structure [NASA-CASE-LAR-13113-1]
                                     p 65 N87-22715
 methodology
                                                                                                  p 36 N87-25492
   Commit your works to the Lord, and your thoughts shall
                                                                Development of intelligent structures using finite control
 be established (Prov. 16:3). Inter-stable control systems
                                                              elements in a hierarchic and distributed control system
   p 9 N87-22716
Status report and preliminary results of the spacecraft
                                                              [AD-A179711]
                                                                                                   p 72 N87-25805
                                                                Nuclear reactor power for a space-based radar. SP-100
 control laboratory experiment
   An overview of controls research on the NASA Langley
                                                              [NASA-TM-89295]
                                                                                                   p 79 N87-25838
 Research Center grid
                                     p 66 N87-22720
                                                                Response of joint dominated space structures
   Precision pointing and control of flexible spacecraft
                                                                                                  p 36 N87-26071
                                                              INASA-CR-1805641
                                     p 66 N87-22723
                                                                Joint nonlinearity effects in the design of a flexible truss
   Structural Dynamics and Control Interaction of Flexible
                                                               structure control system
                                                                                                   p 37 N87-26365
                                                              [NASA-CR-180633]
 [NASA-CP-2467-PT-21
                                     p 66 N87-22729
                                                                Response of joint dominated space structures
   Vibration suppression by stiffness control
                                                              [NASA-CR-181202]
                                                                                                  p 37 N87-26397
                                          N87-22730
                                                                An investigation of methodology for the control and
   Control of flexible structures and the research
                                                              failure identification of flexible structures
                                     p 66 N87-22732
 community
                                                                                                  p 38 N87-26921
     TREETOPS simulation of the Hubble Space
                                                                Theory and application of linear servo dampers for large
 Telescope-High Gain Antenna interaction
                                                              scale space structures
                                                                                                  p 72 N87-26970
                                      p 9 N87-22735
                                                                Digital control system for space structure dampers
   High speed simulation of flexible multibody dynamics
                                                              [NASA-CR-181253]
                                                                                                  p 72 N87-27704
                                     p 33 N87-22738
                                                                Study on investigation of the attitude control of large
   Maximum Entropy/Optimal Projection (MEOP) control
                                                                     spacecraft. Phase 1, volume 1: Technical report
 design synthesis: Optimal quantification of the major design
                                                              [ESA-CR(P)-2361-VOL-1]
                                                                                                  p 73 N87-27706
  adeoffs p 9 N87-22741
A new approach for vibration control in large space
 tradeoffs
                                                                Study on investigation of the attitude control of large
                                                              flexible spacecraft. Phase 2, volume 1: Executive summary
 structures
                                     p 33 N87-22743
                                                               - laboratory test model
  Modeling of controlled flexible structures with impulsive
                                                              [ESA-CR(P)-2361-VOL-1]
                                                                                                   p 73 N87-27707
                                     p 33 N87-22745
loads
                                                                Study on the investigation of the attitude control of large
  On the control of structures by applied thermal
                                                              flexible spacecraft. Phase 2, volume 2: Technical report
gradients
                                     p 33 N87-22747

    laboratory test model

  System identification for large space structure damage
                                                             [ESA-CR(P)-2361-VOL-21
                                                                                                  p 73 N87-27708
                                     p 33 N87-22750
                                                               Study on investigation of the attitude control of large
                                                              flexible spacecraft, phase 3
  Adaptive momentum management for large space
                                                              [ESA-CR(P)-2361-VOL-4]
                                                                                                  p 73 N87-27709
                                                                The dynamics and control of large flexible space
[NASA-CR-179085]
                                     p 67 N87-22758
                                                              structures X. part 1
  An integrated, optimization-based approach to the
                                                             [NASA-CR-181287]
                                                                                                  p 73 N87-27712
  esign and control of large space structures
                                                             Preloaded space structural coupling joints
[NASA-CASE-LAR-13489-1] p 38
[AD-A179459]
                                     p 34 N87-23683
                                                                                                  p 38 N87-27713
  Control considerations for high frequency, resonant,
                                                               An experimental investigation of vibration suppression
power processing equipment used in large systems
                                                                large space structures using positive position
NASA-TM-899261
                                    p 68 N87-23690
                                                                                                  p 39 N87-28937
                                                             feedback
  Modified independent modal space control method for
                                                                Technology for Large Space Systems. A bibliography
 active control of flexible systems
                                                             with indexes (supplement 17) [NASA-SP-7046(17)]
[NASA-CR-181065]
                                     p 34 N87-23980
                                                                                                  p 39 N87-29576
  Guidelines for noise and vibration levels for the space
                                                               The 21st Aerospace Mechanisms Symposium
                                                             [NASA-CP-2470]
station
                                                                                                 p 103 N87-29858
[NASA-CR-178310]
                                   p 120 N87-24162
                                                               The design and development of a two-dimensional
  Robust control for large space antennas
                                                              adaptive truss structure
                                                                                                  p 40 N87-29860
                                     p 87 N87-24499
                                                           LASER APPLICATIONS
                                                               Solar array flight dynamic experiment
  Large space systems technology and requirements
                                                             [AAS PAPER 86-050]
                                      p 3 N87-24500
                                                                                                  p 75 A87-32747
                                                               Measuring thermal expansion in large composite
  Controls-structures-electromagnetics
                                            interaction
                                                              structures --- for spaceborne telescopes
                                    p 69 N87-24502
                                                                                                  p 20 A87-38612
  Hoop/column and tetrahedral truss electromagnetic
                                                               Production of pulsed atomic oxygen beams via laser
                                    p 87 N87-24504
                                                              vaporization methods
                                                                                                p 106 A87-38625
  COFS 3 multibody dynamics and control technology
                                                               Remote sensing; Proceedings of the Meeting, Orlando,
                                    p 69 N87-24506
                                                             FL. Apr. 3, 4, 1986
  Antenna Technology Shuttle Experiment (ATSE)
                                                             [SPIE-644]
                                                                                                p 125 A87-44176
                                    p 87 N87-24508
                                                           LASER HEATING
  Structural control by the use of piezoelectric active
                                                               Production of pulsed atomic oxygen beams via laser
                                    p 69 N87-24509
members
                                                               aporization methods
                                                                                                p 109 N87-26190
  Ground test of large flexible structures
                                                           LASER OUTPUTS
                                    p 34 N87-24510
                                                               A high flux pulsed source of energetic atomic oxygen
  Slew maneuvers on the SCOLE Laboratory Facility
                                                               for spacecraft materials ground testing
                                                                                                p 139 A87-38623
                                    p 69 N87-24511
                                                           LASER PLASMAS
  Spectral factorization and homogenization methods for
                                                               High intensity 5 eV CW laser sustained 0-atom exposure
modeling and control of flexible structures
                                                             facility for material degradation studies
(AD-A1797261
                                    p 35 N87-24517
                                                                                                p 105 A87-32060
 Large space structures testing
                                                          LASER PROPULSION
[NASA-TM-100306]
                                    p 35 N87-24520
                                                               Advanced propulsion activities in the USA
 Distributed control using linear momentum exchange
                                                                                                  p 90 A87-41575
                                                            ASER RANGE FINDERS
[NASA-TM-100308]
                                    p 70 N87-24521
                                                               Rendezvous and docking tracker
 Dynamic and thermal response finite element models
                                                             [AAS PAPER 86-014]
                                                                                                p 133 A87-32733
of multi-body space structural configurations
                                                               Laser docking system flight experiment
[NASA-CR-178289]
                                    p 10 N87-24709
                                                             [AAS PAPER 86-043]
                                                                                                 p 99 A87-32745
 Characterization and hardware modification of linear
                                                          LASER WEAPONS
momentum exchange devices
                                                               Joint Optics Structures Experiment (JOSE)
[NASA-TM-86594]
                                    p 70 N87-24723
                                                                                                 p 34 N87-24497
```

Effect of long-term exposure to LEO space environment on spacecraft materials p 106 A87-39426

p 23 A87-48341

LATCHES	Status of the Space Station environmental control and life support system design concept	scale space structures p 72 N87-26970
Preloadable vector sensitive latch [NASA-CASE-MSC-20910-1] p 161 N87-25582	[SAE PAPER 860943] p 48 A87-38730	LINEARIZATION
The preloadable vector sensitive latch for orbital	Environmental Control Life Support for the Space	Response of joint dominated space structures [NASA-CR-180564] p 36 N87-26071
docking/berthing p 162 N87-29876	Station	[NASA-CR-180564] p 36 N87-26071 Response of joint dominated space structures
LATTICE PARAMETERS	[SAE PAPER 860944] p 48 A87-38731	[NASA-CR-181202] p 37 N87-26397
Wave propagation in transversely isotropic continuum	Nuclear powered submarines and the Space Station - A comparison of ECLSS requirements	LINKAGES
models of LSS (Large Space Structures) [AD-A177271] p 30 N87-22256	[SAE PAPER 860945] p 48 A87-38732	Preloadable vector sensitive latch
LATTICES (MATHEMATICS)	Integrated air revitalization system for Space Station	[NASA-CASE-MSC-20910-1] p 161 N87-25582
Reduced modeling and analysis of large repetitive space	[SAE PAPER 860946] p 48 A87-38733	LIQUID CRYSTALS  Head-ported display analysis for Space Station
structures via continuum/discrete concepts p 19 A87-35327	Physiological requirements and pressure control of a	applications p 111 A87-31463
Adaptive identification of flexible structures by lattice	spaceplane [SAE PAPER 860965] p 150 A87-38747	Non-intrusive techniques for thermal measurements in
filters	Columbus Life Support System and its technology	microgravity fluid science experiments
[AIAA PAPER 87-2458] p 24 A87-50504	development	p 151 A87-39836 Developing a voice-controlled, computer-generated
Comparison of wave-mode coordinate and pulse	[SAE PAPER 860966] p 150 A87-38748	display to assist space station astronauts during
summation methods (AD-A177795) p 30 N87-21992	Life Support Subsystem concepts for botanical	maintenance activity
[AD-A177795] p 30 N87-21992  LAUNCH VEHICLES	experiments of long duration [SAE PAPER 860967] p 49 A87-38749	[AD-A178997] p 120 N87-22762
Space launcher upper stages - Design for mission	An evolutionary approach to the development of a	LIQUID FUELS
versatility and/or orbital operation p 132 A87-32474	CELSS based air revitalization system	Overview: Fluid acquisition and transfer p 94 N87-21146
Trends in space transportation p 168 A87-41572	[SAE PAPER 860968] p 49 A87-38750	LIQUID HELIUM
The Soviet space shuttle programme p 153 A87-47302	Pre- and post-treatment techniques for spacecraft water	Transferring superfluid helium in space
Design of a mixed fleet transportation system to low	recovery [SAE PAPER 860982] p 50 A87-38761	p 88 A87-34712
Earth orbit. Volume 1: Executive summary. Volume 2:	Air Evaporation closed cycle water recovery technology	Helium technology issues p 94 N87-21145
Near-term shuttle replacement. Volume 3: Heavy-lift cargo	Advanced energy saving designs	Superfluid helium on orbit transfer (SHOOT) p 95 N87-21151
vehicle. Volume 4: Advanced technology shuttle	[SAE PAPER 860987] p 51 A87-38766	LIQUID PROPELLANT ROCKET ENGINES
replacement p 5 N87-29583	Environmental control and life support technologies for advanced manned space missions	Liquid propulsion technology for expendable and STS
LAYOUTS The use of multidimensional scaling for facilities layout	[SAE PAPER 860994] p 51 A87-38771	launch vehicle transfer stages
- An application to the design of the Space Station	An advanced carbon reactor subsystem for carbon	[AIAA PAPER 87-1934] p 92 A87-45311
p 118 A87-33003	dioxide reduction	LIQUID ROCKET PROPELLANTS  Mixing-induced ullage condensation and fluid
LEAST SQUARES METHOD	[SAE PAPER 860995] p 51 A87-38772	Mixing-induced ullage condensation and fluid destratification
On-line identification and attitude control for SCOLE	Integrated waste and water management system [SAE PAPER 860996] p 51 A87-38773	[AIAA PAPER 87-2018] p 92 A87-45357
[AIAA PAPER 87-2459] p 61 A87-50505 A computer program for model verification of dynamic	[SAE PAPER 860996] p 51 A87-38773 CELSS waste management systems evaluation	Liquid propellant tank ullage bubble deformation and
systems p 31 N87-22710	[SAE PAPER 860997] p 51 A87-38774	breakup in low gravity reorientation
LENGTH	Control/monitor instrumentation for environmental	[AIAA PAPER 87-2021] p 92 A87-45360
Optimal shuttle altitude changes using tethers	control and life support systems aboard the Space	An analysis of bipropellant neutralization for spacecraft refueling operations p 97 N87-25888
[AD-A179205] p 129 N87-22756	Station (SAF PAPER 861007) p 52 A87-38779	LIQUID SLOSHING
LIAPUNOV FUNCTIONS  Adaptive tracking of dynamical model by uncertain	[SAE PAPER 861007] p 52 A87-38779 Proposed application of automated biomonitoring for	The coupled dynamics of fluids and spacecraft in low
nonlinearizable spacecraft	rapid detection of toxic substances in water supplies for	gravity and low gravity fluid measurement
[AIAA PAPER 87-0940] p 57 A87-33738	permanent space stations p 164 A87-40098	p 94 N87-21147
Aeroassisted orbital maneuvering using Lyapunov	Complex system monitoring and fault diagnosis using	LIQUID SURFACES  Non-intrusive techniques for thermal measurements in
optimal feedback control (AIAA PAPER 87-2464) p 93 A87-50509	communicating expert systems p 119 A87-40363 Life support subsystem concepts for botanical	microgravity fluid science experiments
[AIAA PAPER 87-2464] p 93 A87-50509	Life Support Subsystem concepts for botalical	p 151 A87-39836
LIBRATION	experiments of long duration	
LIBRATION  Tethered satellite program control strategy	experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967	LOAD DISTRIBUTION (FORCES)
LIBRATION Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  p 33 N87-22745
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads p 33 N87-22745  LOADING MOMENTS
Tethered satellite program control strategy  [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 98 N87-26130	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads p 33 N87-22745  LOADING MOMENTS  Structural dynamics system model reduction p 32 N87-22727
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 98 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS)	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads p 33 N87-22745  LOADING MOMENTS Structural dynamics system model reduction p 32 N87-22727  LOADS (FORCES)
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY) Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS The multi-disciplinary design study. A life cycle cost algorithm	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 98 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  p 33 N87-22745  LOADING MOMENTS  Structural dynamics system model reduction  p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY) Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 98 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117 LIGHT EMITTING DIODES	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads p 33 N87-22745  LOADING MOMENTS  Structural dynamics system model reduction p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft p 26 N87-20361
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 98 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117  LIGHT EMITTING DIODES Head-ported display analysis for Space Station	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft p 26 N87-20361  Notes on implementation of Coulomb friction in coupled dynamical simulations p 67 N87-22746
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY) Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES Gas and water recycling system for IOC vivarium	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 98 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117 LIGHT EMITTING DIODES Head-ported display analysis for Space Station applications p 111 A87-31463	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft p 26 N87-20361  Notes on implementation of Coulomb friction in coupled dynamical simulations p 67 N87-22746  Substructure analysis using NICE/SPAR and
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity p 46 A87-32457	[MBB-UR-E-907-86-PUB] p 154 A87-49967  Maintenance evaluation for space station liquid systems p 52 N87-21155  Hydrogen/oxygen economy for the space station p 98 N87-26130  Automated Subsystem Control for Life Support System (ASCLSS)  [NASA-CR-172003] p 53 N87-29117  LIGHT EMITTING DIODES  Head-ported display analysis for Space Station applications p 111 A87-31463  LINEAR PROGRAMMING  Optimization of a program of experiments in connection	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads p 33 N87-22745  LOADING MOMENTS Structural dynamics system model reduction p 32 N87-22727  LOADS (FORCES) Structural qualification of large spacecraft p 26 N87-20361  Notes on implementation of Coulomb friction in coupled dynamical simulations p 67 N87-22746 Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity  p 46 A87-32457  Space Station - Opportunities for the life sciences	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 98 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117  LIGHT EMITTING DIODES Head-ported display analysis for Space Station applications p 111 A87-31463  LINEAR PROGRAMMING Optimization of a program of experiments in connection with the operational planning of studies carried out with	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction  p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft  p 26 N87-22736  Notes on implementation of Coulomb friction in coupled dynamical simulations  p 67 N87-22746  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY) Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity p 46 A87-32457  Space Station - Opportunities for the life sciences p 122 A87-34871	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 98 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117 LIGHT EMITTING DIODES Head-ported display analysis for Space Station applications p 111 A87-31463 LINEAR PROGRAMMING Optimization of a program of experiments in connection with the operational planning of studies carried out with a spacecraft p 148 A87-34208	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft p 26 N87-22727  Notes on implementation of Coulomb friction in coupled dynamical simulations p 37 N87-22746  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures spacecraft masts [NASA-CR-180317] p 38 N87-27260
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity  p 46 A87-32457  Space Station - Opportunities for the life sciences p 122 A87-34871  Special considerations in outfitting a space station	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 98 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117 LIGHT EMITTING DIODES Head-ported display analysis for Space Station applications p 111 A87-31463 LINEAR PROGRAMMING Optimization of a program of experiments in connection with the operational planning of studies carried out with a spacecraft p 148 A87-34208 LINEAR QUADRATIC GAUSSIAN CONTROL	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft p 26 N87-22727  Notes on implementation of Coulomb friction in coupled dynamical simulations y 67 N87-22746  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures—spacecraft masts [NASA-CR-180317]  DCAL AREA NETWORKS Star topology spacecraft data bus
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity  p 46 A87-32457  Space Station - Opportunities for the life sciences p 122 A87-34871  Special considerations in outfitting a space station module for scientific use	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 98 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117 LIGHT EMITTING DIODES Head-ported display analysis for Space Station applications p 111 A87-31463 LINEAR PROGRAMMING Optimization of a program of experiments in connection with the operational planning of studies carried out with a spacecraft p 148 A87-34208 LINEAR QUADRATIC GAUSSIAN CONTROL Reduced-order compensation - LQG reduction versus optimal projection	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft p 26 N87-20361  Notes on implementation of Coulomb friction in coupled dynamical simulations p 67 N87-22746  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures—spacecraft masts [NASA-CR-180317] p 38 N87-27260  LOCAL AREA NETWORKS  Star topology spacecraft data bus
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity p 46 A87-32457  Space Station - Opportunities for the life sciences p 122 A87-34871  Special considerations in outfitting a space station module for scientific use	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 98 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117 LIGHT EMITTING DIODES Head-ported display analysis for Space Station applications p 111 A87-31463 LINEAR PROGRAMMING Optimization of a program of experiments in connection with the operational planning of studies carried out with a spacecraft LINEAR QUADRATIC GAUSSIAN CONTROL Reduced-order compensation - LQG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft p 26 N87-20361  Notes on implementation of Coulomb friction in coupled dynamical simulations gubstructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures spacecraft masts [NASA-CR-180317]  LOCAL AREA NETWORKS Star topology spacecraft data bus p 112 A87-37431 GLOBECOM '86 Global Telecommunications
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity  p 46 A87-32457  Space Station - Opportunities for the life sciences p 122 A87-34871  Special considerations in outfitting a space station module for scientific use [SAE PAPER 860956] p 164 A87-38741  Conceptual planning for Space Station life sciences human research project	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 98 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117  LIGHT EMITTING DIODES Head-ported display analysis for Space Station applications p 111 A87-31463  LINEAR PROGRAMMING Optimization of a program of experiments in connection with the operational planning of studies carried out with a spacecraft p 148 A87-34208  LINEAR QUADRATIC GAUSSIAN CONTROL  Reduced-order compensation - LQG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 Improving stability margins in discrete-time LQG	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction  p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft  p 26 N87-20361  Notes on implementation of Coulomb friction in coupled dynamical simulations  p 67 N87-22746  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The mutti-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity  Space Station - Opportunities for the life sciences p 122 A87-34871  Special considerations in outfitting a space station module for scientific use [SAE PAPER 860956] p 164 A87-38751  Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 98 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117  LIGHT EMITTING DIODES Head-ported display analysis for Space Station applications p 111 A87-31463  LINEAR PROGRAMMING Optimization of a program of experiments in connection with the operational planning of studies carried out with a spacecraft p 148 A87-34208  LINEAR QUADRATIC GAUSSIAN CONTROL Reduced-order compensation - LOG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 Improving stability margins in discrete-time LOG controllers	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft p 26 N87-22727  Notes on implementation of Coulomb friction in coupled dynamical simulations year of N87-22746  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity p 46 A87-32457  Space Station - Opportunities for the life sciences p 122 A87-34871  Special considerations in outfitting a space station module for scientific use [SAE PAPER 860956] p 164 A87-38741  Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751 Life Sciences Research Facility automation	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 98 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117 LIGHT EMITTING DIODES Head-ported display analysis for Space Station applications p 111 A87-31463 LINEAR PROGRAMMING Optimization of a program of experiments in connection with the operational planning of studies carried out with a spacecraft p 148 A87-34208 LINEAR QUADRATIC GAUSSIAN CONTROL Reduced-order compensation - LQG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 Improving stability margins in discrete-time LQG controllers LINEAR QUADRATIC REGULATOR	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft p 26 N87-20361  Notes on implementation of Coulomb friction in coupled dynamical simulations p 67 N87-22746  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity p 46 A87-32457  Space Station - Opportunities for the life sciences p 122 A87-34871  Special considerations in outfitting a space station module for scientific use [SAE PAPER 860956] p 164 A87-38741  Conceptual planning for Space Station life sciences human research project [SAE PAPER 860959] p 164 A87-38751  Life Sciences Research Facility automation requirements and concepts for the Space Station	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 98 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117  LIGHT EMITTING DIODES Head-ported display analysis for Space Station applications p 111 A87-31463  LINEAR PROGRAMMING Optimization of a program of experiments in connection with the operational planning of studies carried out with a spacecraft p 148 A87-34208  LINEAR QUADRATIC GAUSSIAN CONTROL Reduced-order compensation - LQG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 Improving stability margins in discrete-time LQG controllers An analytical and experimental investigation of output	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft p 26 N87-20361  Notes on implementation of Coulomb friction in coupled dynamical simulations Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures spacecraft masts [NASA-CR-180317]  LOCAL AREA NETWORKS  Star topology spacecraft data bus CLOCAL AREA NETWORKS  Star topology spacecraft data bus GLOBECOM '86 - Global Telecommunications Conference, Houston, TX, Dec. 1-4, 1986, Conference Record. Volumes 1, 2, 8 3 Advanced local area network concepts
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity p 46 A87-32457  Space Station - Opportunities for the life sciences p 122 A87-34871  Special considerations in outfitting a space station module for scientific use [SAE PAPER 860956] p 164 A87-38741  Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  Life Sciences Research Facility automation requirements and concepts for the Space Station [SAE PAPER 860970] p 50 A87-38752	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 98 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117 LIGHT EMITTING DIODES Head-ported display analysis for Space Station applications p 111 A87-31463 LINEAR PROGRAMMING Optimization of a program of experiments in connection with the operational planning of studies carried out with a spacecraft p 148 A87-34208 LINEAR QUADRATIC GAUSSIAN CONTROL Reduced-order compensation - LQG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 Improving stability margins in discrete-time LQG controllers LINEAR QUADRATIC REGULATOR	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft p 26 N87-20361  Notes on implementation of Coulomb friction in coupled dynamical simulations p 67 N87-22746  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures spacecraft masts [NASA-CR-180317]  LOCAL AREA NETWORKS  Star topology spacecraft data bus p 112 A87-37431  GLOBECOM '86 - Global Telecommunications Conference, Houston, TX, Dec. 1-4, 1986, Conference Record, Volumes 1, 2, & 3 Advanced local area network concepts Advanced local area network concepts p 117 N87-29153 Network reliability p 117 N87-29157
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity p 46 A87-32457  Space Station - Opportunities for the life sciences p 122 A87-34871  Special considerations in outfitting a space station module for scientific use [SAE PAPER 860956] p 164 A87-38741  Conceptual planning for Space Station life sciences human research project [SAE PAPER 860959] p 164 A87-38751  Life Sciences Research Facility automation requirements and concepts for the Space Station [SAE PAPER 860970] p 50 A87-38752  Life Science Research Facility materials management requirements and concepts	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 8 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117  LIGHT EMITTING DIODES Head-ported display analysis for Space Station applications p 111 A87-31463  LINEAR PROGRAMMING Optimization of a program of experiments in connection with the operational planning of studies carried out with a spacecraft p 148 A87-34208  LINEAR QUADRATIC GAUSSIAN CONTROL Reduced-order compensation - LQG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 Improving stability margins in discrete-time LQG controllers An analytical and experimental investigation of output feedback vs. linear quadratic regulator for large space structures [AIAA PAPER 87-2390] p 61 A87-50474	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft p 26 N87-20361  Notes on implementation of Coulomb friction in coupled dynamical simulations gubstructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures spacecraft masts [NASA-CR-180317]  LOCAL AREA NETWORKS Star topology spacecraft data bus GLOBECOM '86 - Global Telecommunications Conference, Houston, TX, Dec. 1-4, 1986, Conference Record, Volumes 1, 2, & 3 p 169 A87-4576  Advanced local area network concepts p 117 N87-29153 Network reliability p 117 N87-29157  LOCKS (FASTENERS) Collect lock joint for space station truss
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity p 46 A87-32457  Space Station - Opportunities for the life sciences p 122 A87-34871  Special considerations in outfitting a space station module for scientific use [SAE PAPER 860956] p 164 A87-38741  Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  Life Sciences Research Facility automation requirements and concepts for the Space Station [SAE PAPER 860970] p 50 A87-38752  Life Science Research Facility materials management requirements and concepts [SAE PAPER 860974] p 124 A87-38756	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 98 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117  LIGHT EMITTING DIODES Head-ported display analysis for Space Station applications p 111 A87-31463  LINEAR PROGRAMMING Optimization of a program of experiments in connection with the operational planning of studies carried out with a spacecraft p 148 A87-34208  LINEAR QUADRATIC GAUSSIAN CONTROL Reduced-order compensation - LQG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 Improving stability margins in discrete-time LQG controllers An analytical and experimental investigation of output feedback vs. linear quadratic regulator for large space structures [AIAA PAPER 87-2390] p 61 A87-50474 Linear quadratic control system design for Space Station	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction  p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft  p 26 N87-20361  Notes on implementation of Coulomb friction in coupled dynamical simulations  p 67 N87-22746  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures spacecraft masts [NASA-CR-180317]  LOCAL AREA NETWORKS  Star topology spacecraft data bus  p 112 A87-37431  GLOBECOM '86 - Global Telecommunications  Conference, Houston, TX, Dec. 1-4, 1986, Conference Record. Volumes 1, 2, 8, 3 p 169 A87-45476  Advanced local area network concepts  Network reliability p 117 N87-29157  LOCKS (FASTENERS)  Collect lock joint for space station truss [NASA-CASE-MSC-21207-1] p 36 N87-25576
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity  p 46 A87-32457  Space Station - Opportunities for the life sciences p 122 A87-34871  Special considerations in outfitting a space station module for scientific use [SAE PAPER 860956] p 164 A87-38741  Conceptual planning for Space Station life sciences human research project [SAE PAPER 860970] p 164 A87-38751  Life Science Research Facility automation requirements and concepts for the Space Station [SAE PAPER 860970] p 50 A87-38752  Life Science Research Facility materials management requirements and concepts [SAE PAPER 860974] p 124 A87-38756  Soviet space stations as analogs, second edition	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 8 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117 LIGHT EMITTING DIODES Head-ported display analysis for Space Station applications p 111 A87-31463 LINEAR PROGRAMMING Optimization of a program of experiments in connection with the operational planning of studies carried out with a spacecraft p 148 A87-34208 LINEAR QUADRATIC GAUSSIAN CONTROL Reduced-order compensation - LOG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 Improving stability margins in discrete-time LOG controllers p 31 N87-22719 LINEAR QUADRATIC REGULATOR An analytical and experimental investigation of output feedback vs. linear quadratic regulator for large space structures [AIAA PAPER 87-2390] p 61 A87-50474 Linear quadratic control system design for Space Station pointed payloads	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction  p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft  p 26 N87-20361  Notes on implementation of Coulomb friction in coupled dynamical simulations  p 67 N87-22746  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity p 46 A87-32457  Space Station - Opportunities for the life sciences p 122 A87-34871  Special considerations in outfitting a space station module for scientific use [SAE PAPER 860956] p 164 A87-38741  Conceptual planning for Space Station life sciences human research project [SAE PAPER 860959] p 164 A87-38751  Life Sciences Research Facility automation requirements and concepts for the Space Station [SAE PAPER 860970] p 50 A87-38752  Life Science Research Facility materials management requirements and concepts [SAE PAPER 860974] p 124 A87-38756  Soviet space stations as analogs, second edition [NASA-CR-180920] p 157 N87-21996	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 8 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117 LIGHT EMITTING DIODES Head-ported display analysis for Space Station applications p 111 A87-31463 LINEAR PROGRAMMING Optimization of a program of experiments in connection with the operational planning of studies carried out with a spacecraft p 148 A87-34208 LINEAR QUADRATIC GAUSSIAN CONTROL Reduced-order compensation - LOG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 Improving stability margins in discrete-time LOG controllers LINEAR QUADRATIC REGULATOR An analytical and experimental investigation of output feedback vs. linear quadratic regulator for large space structures [AIAA PAPER 87-2390] p 61 A87-50474 Linear quadratic control system design for Space Station pointed payloads [AIAA PAPER 87-2530] p 161 A87-50533	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft p 26 N87-20361  Notes on implementation of Coulomb friction in coupled dynamical simulations Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures spacecraft masts [NASA-CR-180317]  LOCAL AREA NETWORKS  Star topology spacecraft data bus Conference, Houston, TX, Dec. 1-4, 1986, Conference Record, Volumes 1, 2, & 3 Advanced local area network concepts P 117 N87-29153 Network reliability P 36 N87-2576  LOCKS (FASTENERS) Collect lock joint for space station truss [NASA-CASE-MSC-21207-1] P 36 N87-25576  LOGIC CIRCUITS Attitude control of a spacecraft using an extended
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity  p 46 A87-32457  Space Station - Opportunities for the life sciences p 122 A87-34871  Special considerations in outfitting a space station module for scientific use [SAE PAPER 860956] p 164 A87-38741  Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  Life Sciences Research Facility automation requirements and concepts for the Space Station [SAE PAPER 860970] p 50 A87-38752  Life Science Research Facility materials management requirements and concepts [SAE PAPER 860974] p 124 A87-38756  Soviet space stations as analogs, second edition [NASA-CR-180820] p 157 N87-21996  LIFE SUPPORT SYSTEMS  Preliminary experimental study on the oxygen separating	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 8 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117 LIGHT EMITTING DIODES Head-ported display analysis for Space Station applications p 111 A87-31463 LINEAR PROGRAMMING Optimization of a program of experiments in connection with the operational planning of studies carried out with a spacecraft p 148 A87-34208 LINEAR QUADRATIC GAUSSIAN CONTROL Reduced-order compensation - LOG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 Improving stability margins in discrete-time LOG controllers p 31 N87-22719 LINEAR QUADRATIC REGULATOR An analytical and experimental investigation of output feedback vs. linear quadratic regulator for large space structures [AIAA PAPER 87-2390] p 61 A87-50474 Linear quadratic control system design for Space Station pointed payloads	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft p 26 N87-20361  Notes on implementation of Coulomb friction in coupled dynamical simulations Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures spacecraft masts [NASA-CR-180317]  LOCAL AREA NETWORKS  Star topology spacecraft data bus p 1112 A87-37431  GLOBECOM '86 - Global Telecommunications Conference, Houston, TX, Dec. 1-4, 1986, Conference Record, Volumes 1, 2, & 3 p 169 A87-45476  Advanced local area network concepts p 117 N87-29153 Network reliability p 117 N87-29157  LOCKS (FASTENERS) Collect lock joint for space station truss [NASA-CASE-MSC-21207-1] p 36 N87-25576  LOGIC CIRCUITS Attitude control of a spacecraft using an extended
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity p 46 A87-32457  Space Station - Opportunities for the life sciences p 122 A87-34871  Special considerations in outfitting a space station module for scientific use [SAE PAPER 860956] p 164 A87-38741  Conceptual planning for Space Station life sciences human research project [SAE PAPER 860959] p 164 A87-38751  Life Sciences Research Facility automation requirements and concepts for the Space Station [SAE PAPER 860970] p 50 A87-38752  Life Science Research Facility materials management requirements and concepts [SAE PAPER 860974] p 124 A87-38756  Soviet space stations as analogs, second edition [NASA-CR-180920] p 157 N87-21996  LIFE SUPPORT SYSTEMS  Preliminary experimental study on the oxygen separating and concentrating system for CELSS p 46 A87-32455	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 98 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117 LIGHT EMITTING DIODES Head-ported display analysis for Space Station applications p 111 A87-31463 LINEAR PROGRAMMING Optimization of a program of experiments in connection with the operational planning of studies carried out with a spacecraft LINEAR QUADRATIC GAUSSIAN CONTROL Reduced-order compensation - LQG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 Improving stability margins in discrete-time LQG controllers LINEAR QUADRATIC REGULATOR An analytical and experimental investigation of output feedback vs. linear quadratic regulator for large space structures [AIAA PAPER 87-2390] p 61 A87-50474 Linear quadratic control system design for Space Station pointed payloads [AIAA PAPER 87-2530] p 161 A87-50533 Improving stability margins in discrete-time LQG controllers p 31 N87-22719 LINEAR SYSTEMS	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft p 26 N87-20361  Notes on implementation of Coulomb friction in coupled dynamical simulations substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures — spacecraft masts [NASA-CR-180317]  LOCAL AREA NETWORKS  Star topology spacecraft data bus p 112 A87-37431  GLOBECOM '86 - Global Telecommunications Conference, Houston, TX, Dec. 1-4, 1986, Conference Record, Volumes 1, 2, & 3 p 169  Advanced local area network concepts p 117 N87-29153  Network reliability p 117 N87-29157  LOCKS (FASTENERS) Collect lock joint for space station truss [NASA-CASE-MSC-21207-1] p 36 N87-25576  LOGIC CIRCUITS Attitude control of a spacecraft using an extended self-organizing fuzzy logic controller  LOGISTICS  Space Shuttle flight rates and utilization
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity  p 46 A87-32457  Space Station - Opportunities for the life sciences p 122 A87-34871  Special considerations in outfitting a space station module for scientific use [SAE PAPER 860956] p 164 A87-38741  Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  Life Sciences Research Facility automation requirements and concepts for the Space Station [SAE PAPER 860970] p 50 A87-38752  Life Science Research Facility materials management requirements and concepts [SAE PAPER 860974] p 124 A87-38756  Soviet space stations as analogs, second edition [INASA-CR-180920] p 157 N87-21996  LIFE SUPPORT SYSTEMS  Preliminary experimental study on the oxygen separating and concentrating system for CELSS p 46 A87-32455  Development of carbon dioxide removal system -	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 98 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117  LIGHT EMITTING DIODES Head-ported display analysis for Space Station applications p 111 A87-31463  LINEAR PROGRAMMING Optimization of a program of experiments in connection with the operational planning of studies carried out with a spacecraft p 148 A87-34208  LINEAR QUADRATIC GAUSSIAN CONTROL Reduced-order compensation - LOG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 Improving stability margins in discrete-time LOG controllers LINEAR QUADRATIC REGULATOR An analytical and experimental investigation of output feedback vs. linear quadratic regulator for large space structures [AIAA PAPER 87-2390] p 61 A87-50474 Linear quadratic control system design for Space Station pointed payloads [AIAA PAPER 87-2530] p 161 A87-50533 Improving stability margins in discrete-time LOG controllers  LINEAR SYSTEMS  Maximum likelihood identification using an array	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft p 26 N87-20361  Notes on implementation of Coulomb friction in coupled dynamical simulations gubstructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures spacecraft masts [NASA-CR-180317]  LOCAL AREA NETWORKS  Star topology spacecraft data bus GLOBECOM '86 - Global Telecommunications Conference, Houston, TX, Dec. 1-4, 1986, Conference Record. Volumes 1, 2, 8 3 p 169 A87-45476  Advanced local area network concepts P 117 N87-29153 Network reliability DCKS (FASTENERS) Collect lock joint for space station truss [NASA-CASE-MSC-21207-1] P 36 N87-25576  LOCIC CIRCUITS Attitude control of a spacecraft using an extended self-organizing fuzzy logic controller P 59 A87-41617  LOCISTICS Space Shuttle flight rates and utilization P 1 A87-37963
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity  p 46 A87-32457  Space Station - Opportunities for the life sciences p 122 A87-34871  Special considerations in outfitting a space station module for scientific use [SAE PAPER 860956] p 164 A87-38741  Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  Life Sciences Research Facility automation requirements and concepts for the Space Station [SAE PAPER 860970] p 50 A87-38752  Life Science Research Facility materials management requirements and concepts [SAE PAPER 860974] p 124 A87-38756  Soviet space stations as analogs, second edition [NASA-CR-180920] p 157 N87-21996  LIFE SUPPORT SYSTEMS  Preliminary experimental study on the oxygen separating and concentrating system for CELSS p 46 A87-32455  Development of carbon dioxide removal system - Experimental study of solid amines p 145 A87-32456	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 88 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117 LIGHT EMITTING DIODES Head-ported display analysis for Space Station applications p 111 A87-31463 LINEAR PROGRAMMING Optimization of a program of experiments in connection with the operational planning of studies carried out with a spacecraft p 148 A87-34208 LINEAR QUADRATIC GAUSSIAN CONTROL Reduced-order compensation - LOG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 Improving stability margins in discrete-time LOG controllers p 31 N87-22719 LINEAR QUADRATIC REGULATOR An analytical and experimental investigation of output feedback vs. linear quadratic regulator for large space structures [AIAA PAPER 87-2390] p 61 A87-50474 Linear quadratic control system design for Space Station pointed payloads [AIAA PAPER 87-2530] p 161 A87-50533 Improving stability margins in discrete-time LOG controllers p 31 N87-22719 LINEAR SYSTEMS Maximum likelihood identification using an array processor p 5 A87-32121	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction  p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft  p 26 N87-20361  Notes on implementation of Coulomb friction in coupled dynamical simulations  p 67 N87-22746  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures spacecraft masts [NASA-CR-180317]  LOCAL AREA NETWORKS  Star topology spacecraft data bus  p 112 A87-37431  GLOBECOM '86 - Global Telecommunications  Conference, Houston, TX, Dec. 1-4, 1986, Conference Record. Volumes 1, 2, & 3 p 169 A87-45476  Advanced local area network concepts  p 117 N87-29153  Network reliability  p 117 N87-29157  LOCKS (FASTENERS)  Collect lock joint for space station truss [NASA-CASE-MSC-21207-1]  Attitude control of a spacecraft using an extended self-organizing fuzzy logic controller  p 59 A87-41617  LOGISTICS  Space Shuttle flight rates and utilization  p 1 A87-37963  LONG DURATION SPACE FLIGHT
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity p 46 A87-32457  Space Station - Opportunities for the life sciences p 122 A87-34871  Special considerations in outfitting a space station module for scientific use [SAE PAPER 860956] p 164 A87-38741  Conceptual planning for Space Station life sciences human research project [SAE PAPER 860956] p 164 A87-38751  Life Science Research Facility automation requirements and concepts for the Space Station [SAE PAPER 860970] p 50 A87-38752  Life Science Research Facility materials management requirements and concepts [SAE PAPER 860974] p 124 A87-38756  Soviet space stations as analogs, second edition [NASA-CR-180920] p 157 N87-21996  LIFE SUPPORT SYSTEMS  Preliminary experimental study on the oxygen separating and concentrating system for CELSS p 46 A87-32455  Development of carbon dioxide removal system - Experimental study of solid amines p 145 A87-32456  Concept study of regenerable carbon dioxide removal	MBB-UR-E-907-86-PUB   p 154 A87-49967   Maintenance evaluation for space station liquid systems p 52 N87-21155   Hydrogen/oxygen economy for the space station p 98 N87-26130   Automated Subsystem Control for Life Support System (ASCLSS)   NASA-CR-172003   p 53 N87-29117   LIGHT EMITTING DIODES   Head-ported display analysis for Space Station applications p 111 A87-31463   LINEAR PROGRAMMING   Optimization of a program of experiments in connection with the operational planning of studies carried out with a spacecraft p 148 A87-34208   LINEAR QUADRATIC GAUSSIAN CONTROL   Reduced-order compensation - LOG reduction versus optimal projection   [AIAA PAPER 87-2388] p 61 A87-50472   Improving stability margins in discrete-time LOG controllers p 187-22719   LINEAR QUADRATIC REGULATOR   An analytical and experimental investigation of output feedback vs. linear quadratic regulator for large space structures   [AIAA PAPER 87-2390] p 61 A87-50474   Linear quadratic control system design for Space Station pointed payloads   [AIAA PAPER 87-2530] p 161 A87-50533   Improving stability margins in discrete-time LOG controllers p 31 N87-22719   LINEAR SYSTEMS   Maximum likelihood identification using an array processor   p 5 A87-32121   MOVER II - A computer program for verifying	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction  p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft  p 26 N87-22736  Notes on implementation of Coulomb friction in coupled dynamical simulations  p 67 N87-22746  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures spacecraft masts  [NASA-CR-180317]  LOCAL AREA NETWORKS  Star topology spacecraft data bus  p 112 A87-37431  GLOBECOM '86 - Global Telecommunications  Conference, Houston, TX, Dec. 1-4, 1986, Conference Record. Volumes 1, 2, & 3 p 169 A87-45476  Advanced local area network concepts  Network reliability  p 117 N87-29157  LOCKS (FASTENERS)  Collect lock joint for space station truss  [NASA-CASE-MSC-21207-1]  p 36 N87-25576  LOGIC CIRCUITS  Attitude control of a spacecraft using an extended self-organizing fuzzy logic controller  p 59 A87-41617  LOGISTICS  Space Shuttle flight rates and utilization  p 1 A87-37963  LONG DURATION SPACE FLIGHT  A question of gravity  p 1 A87-32116
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity  p 46 A87-32457  Space Station - Opportunities for the life sciences p 122 A87-34871  Special considerations in outfitting a space station module for scientific use [SAE PAPER 860956] p 164 A87-38741  Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  Life Sciences Research Facility automation requirements and concepts for the Space Station [SAE PAPER 860970] p 50 A87-38752  Life Science Research Facility materials management requirements and concepts [SAE PAPER 860974] p 124 A87-38756  Soviet space stations as analogs, second edition [NASA-CR-180920] p 157 N87-21996  LIFE SUPPORT SYSTEMS  Preliminary experimental study on the oxygen separating and concentrating system for CELSS p 46 A87-32455  Development of carbon dioxide removal system - Experimental study of solid amines p 145 A87-32456	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 88 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117 LIGHT EMITTING DIODES Head-ported display analysis for Space Station applications p 111 A87-31463 LINEAR PROGRAMMING Optimization of a program of experiments in connection with the operational planning of studies carried out with a spacecraft p 148 A87-34208 LINEAR QUADRATIC GAUSSIAN CONTROL Reduced-order compensation - LOG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 Improving stability margins in discrete-time LOG controllers p 31 N87-22719 LINEAR QUADRATIC REGULATOR An analytical and experimental investigation of output feedback vs. linear quadratic regulator for large space structures [AIAA PAPER 87-2390] p 61 A87-50474 Linear quadratic control system design for Space Station pointed payloads [AIAA PAPER 87-2530] p 161 A87-50533 Improving stability margins in discrete-time LOG controllers p 31 N87-22719 LINEAR SYSTEMS  Maximum likelihood identification using an array processor p 5 A87-32121 MOVER II - A computer program for verifying reduced-order models of large dynamic systems [SAE PAPER 861790] p 5 A87-32639	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction p 32 N87-22725  LOADS (FORCES)  Structural qualification of large spacecraft p 26 N87-20361  Notes on implementation of Coulomb friction in coupled dynamical simulations p 67 N87-22746  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures spacecraft masts [NASA-CR-180317]  LOCAL AREA NETWORKS  Star topology spacecraft data bus p 112 A87-37431  GLOBECOM '86 - Global Telecommunications Conference, Houston, TX, Dec. 1-4, 1986, Conference Record, Volumes 1, 2, & 3 p 169 Advanced local area network concepts p 117 N87-29153  Network reliability p 117 N87-29157  LOCKS (FASTENERS) Collect lock joint for space station truss [NASA-CASE-MSC-21207-1] p 36 N87-25576  LOGIC CIRCUITS Attitude control of a spacecraft using an extended self-organizing fuzzy logic controller  LOGISTICS Space Shuttle flight rates and utilization p 1 A87-37963  LONG DURATION SPACE FLIGHT A question of gravity p 1 A87-32116 Space Station personal hygiene study
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity p 46 A87-32457  Space Station - Opportunities for the life sciences p 122 A87-34871  Special considerations in outfitting a space station module for scientific use [SAE PAPER 860956] p 164 A87-38741  Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  Life Sciences Research Facility automation requirements and concepts for the Space Station [SAE PAPER 860970] p 50 A87-38752  Life Science Research Facility materials management requirements and concepts [SAE PAPER 860971] p 124 A87-38756  Soviet space stations as analogs, second edition [NASA-CR-180920] p 157 N87-21996  LIFE SUPPORT SYSTEMS  Preliminary experimental study on the oxygen separating and concentrating system for CELSS p 46 A87-32455  Development of carbon dioxide removal and oxygen recovery system for the Space Station p 46 A87-32544  EDC development and testing for the Space Station	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 88 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117 LIGHT EMITTING DIODES Head-ported display analysis for Space Station applications p 111 A87-31463 LINEAR PROGRAMMING Optimization of a program of experiments in connection with the operational planning of studies carried out with a spacecraft p 148 A87-34208 LINEAR QUADRATIC GAUSSIAN CONTROL Reduced-order compensation - LOG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 Improving stability margins in discrete-time LOG controllers p 31 N87-22719 LINEAR QUADRATIC REGULATOR An analytical and experimental investigation of output feedback vs. linear quadratic regulator for large space structures [AIAA PAPER 87-2390] p 61 A87-50474 Linear quadratic control system design for Space Station pointed payloads [AIAA PAPER 87-2530] p 161 A87-50533 Improving stability margins in discrete-time LOG controllers p 31 N87-22719 LINEAR SYSTEMS Maximum likelihood identification using an array processor p 5 A87-32121 MOVER II - A computer program for verifying reduced-order models of large dynamic systems [SAE PAPER 861790] p 5 A87-32639 An identification method for flexible structures	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft p 26 N87-20361  Notes on implementation of Coulomb friction in coupled dynamical simulations p 67 N87-22746  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures spacecraft masts [NASA-CR-180317]  LOCAL AREA NETWORKS Star topology spacecraft data bus p 112 A87-37431  GLOBECOM '86 - Global Telecommunications Conference, Houston, TX, Dec. 1-4, 1986, Conference Record, Volumes 1, 2, 8 3 p 169 A87-45476  Advanced local area network concepts p 117 N87-29153 Network reliability p 117 N87-29157  LOCKS (FASTENERS) Collect lock joint for space station truss [NASA-CASE-MSC-21207-1] p 36 N87-25576  LOGIC CIRCUITS Attitude control of a spacecraft using an extended self-organizing fuzzy logic controller p 59 A87-41617  LOGISTICS Space Shuttle flight rates and utilization p 1 A87-37963  LONG DURATION SPACE FLIGHT A question of gravity p 1 A87-32116 Space Station personal hygiene study [SAE PAPER 860931]
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity p 46 A87-32457  Space Station - Opportunities for the life sciences p 122 A87-34871  Special considerations in outfitting a space station module for scientific use [SAE PAPER 860956] p 164 A87-38741  Conceptual planning for Space Station life sciences human research project [SAE PAPER 860959] p 164 A87-38751  Life Sciences Research Facility automation requirements and concepts for the Space Station [SAE PAPER 860970] p 50 A87-38752  Life Science Research Facility materials management requirements and concepts [SAE PAPER 860974] p 124 A87-38756  Soviet space stations as analogs, second edition [NASA-CR-180920] p 157 N87-21996  LIFE SUPPORT SYSTEMS  Preliminary experimental study on the oxygen separating and concentrating system for CELSS p 46 A87-32455  Development of carbon dioxide removal system - Experimental study of solid amines p 145 A87-32456  Concept study of regenerable carbon dioxide removal and oxygen recovery system for the Space Station p 46 A87-32544  EDC development and testing for the Space Station program Electrochemical Carbon Dioxide	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 8 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117  LIGHT EMITTING DIODES Head-ported display analysis for Space Station applications p 111 A87-31463  LINEAR PROGRAMMING Optimization of a program of experiments in connection with the operational planning of studies carried out with a spacecraft p 148 A87-34208  LINEAR QUADRATIC GAUSSIAN CONTROL Reduced-order compensation - LOG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 Improving stability margins in discrete-time LOG controllers LINEAR QUADRATIC REGULATOR An analytical and experimental investigation of output feedback vs. linear quadratic regulator for large space structures [AIAA PAPER 87-2390] p 61 A87-50474 Linear quadratic control system design for Space Station pointed payloads [AIAA PAPER 87-2530] p 161 A87-50533 Improving stability margins in discrete-time LOG controllers  LINEAR SYSTEMS  Maximum likelihood identification using an array processor p 5 A87-32121 MOVER II - A computer program for verifying reduced-order models of large dynamic systems [SAE PAPER 861790] p 5 A87-32639 An identification method for flexible structures	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft p 26 N87-20361  Notes on implementation of Coulomb friction in coupled dynamical simulations p 67 N87-22746  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures spacecraft masts [NASA-CR-180317]  LOCAL AREA NETWORKS  Star topology spacecraft data bus p 112 A87-37431  GLOBECOM '86 - Global Telecommunications Conference, Houston, TX, Dec. 1-4, 1986, Conference Record. Volumes 1, 2, 8, 3 p 169 A87-45476  Advanced local area network concepts p 117 N87-29157  Network reliability p 117 N87-29157  LOCKS (FASTENERS) Collect lock joint for space station truss [NASA-CASE-MSC-21207-1] p 36 N87-25576  LOGIC CIRCUITS Attitude control of a spacecraft using an extended self-organizing fuzzy logic controller  LOGISTICS Space Shuttle flight rates and utilization p 1 A87-37963  LONG DURATION SPACE FLIGHT A question of gravity p 1 A87-32116 Space Station personal hygiene study [SAE PAPER 860331] p 163 A87-38721  Life Support Subsystem concepts for botanical
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity  p 46 A87-32457  Space Station - Opportunities for the life sciences p 122 A87-34871  Special considerations in outfitting a space station module for scientific use [SAE PAPER 860956] p 164 A87-38741  Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  Life Sciences Research Facility automation requirements and concepts for the Space Station [SAE PAPER 860970] p 50 A87-38752  Life Science Research Facility materials management requirements and concepts [SAE PAPER 860974] p 124 A87-38756  Soviet space stations as analogs, second edition [NASA-CR-180920] p 157 N87-21996  LIFE SUPPORT SYSTEMS  Preliminary experimental study on the oxygen separating and concentrating system for CELSS p 46 A87-32455  Development of carbon dioxide removal system - Experimental study of solid amines p 145 A87-32456  Concept study of regenerable carbon dioxide removal and oxygen recovery system for the Space Station p 46 A87-32544  EDC development and testing for the Space Station Pooral P	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 88 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117 LIGHT EMITTING DIODES Head-ported display analysis for Space Station applications p 111 A87-31463 LINEAR PROGRAMMING Optimization of a program of experiments in connection with the operational planning of studies carried out with a spacecraft p 148 A87-34208 LINEAR QUADRATIC GAUSSIAN CONTROL Reduced-order compensation - LOG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 Improving stability margins in discrete-time LOG controllers p 31 N87-22719 LINEAR QUADRATIC REGULATOR An analytical and experimental investigation of output feedback vs. linear quadratic regulator for large space structures [AIAA PAPER 87-2390] p 61 A87-50474 Linear quadratic control system design for Space Station pointed payloads [AIAA PAPER 87-2530] p 161 A87-50533 Improving stability margins in discrete-time LOG controllers p 31 N87-22719 LINEAR SYSTEMS  Maximum likelihood identification using an array processor p 5 A87-32121 MOVER II - A computer program for verifying reduced-order models of large dynamic systems [SAE PAPER 861790] p 5 A87-32639 An identification method for flexible structures [AIAA PAPER 87-0745] p 16 A87-33669 Stability of time varying linear systems	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft p 26 N87-20361  Notes on implementation of Coulomb friction in coupled dynamical simulations p 67 N87-22746  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures spacecraft masts [NASA-CR-180317]  LOCAL AREA NETWORKS Star topology spacecraft data bus p 112 A87-37431  GLOBECOM '86 - Global Telecommunications Conference, Houston, TX, Dec. 1-4, 1986, Conference Record, Volumes 1, 2, 8 3 p 169 A87-45476  Advanced local area network concepts p 117 N87-29153 Network reliability p 117 N87-29157  LOCKS (FASTENERS) Collect lock joint for space station truss [NASA-CASE-MSC-21207-1] p 36 N87-25576  LOGIC CIRCUITS Attitude control of a spacecraft using an extended self-organizing fuzzy logic controller p 59 A87-41617  LOGISTICS Space Shuttle flight rates and utilization p 1 A87-37963  LONG DURATION SPACE FLIGHT A question of gravity p 1 A87-32116 Space Station personal hygiene study [SAE PAPER 860931]
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity p 46 A87-32457  Space Station - Opportunities for the life sciences p 122 A87-34871  Special considerations in outfitting a space station module for scientific use [SAE PAPER 860956] p 164 A87-38741  Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751  Life Sciences Research Facility automation requirements and concepts for the Space Station [SAE PAPER 860970] p 50 A87-38752  Life Science Research Facility materials management requirements and concepts [SAE PAPER 860971] p 124 A87-38756  Soviet space stations as analogs, second edition [NASA-CR-180920] p 157 N87-21996  LIFE SUPPORT SYSTEMS  Preliminary experimental study on the oxygen separating and concentrating system for CELSS p 46 A87-32455  Development of carbon dioxide removal system - Experimental study of solid amines p 145 A87-32456  Concept study of regenerable carbon dioxide removal and oxygen recovery system for the Space Station p 46 A87-32544  EDC development and testing for the Space Station P 346 A87-32544  EDC development and testing for the Space Station P 346 A87-32544	MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 98 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117 LIGHT EMITTING DIODES Head-ported display analysis for Space Station applications p 111 A87-31463 LINEAR PROGRAMMING Optimization of a program of experiments in connection with the operational planning of studies carried out with a spacecraft p 148 A87-34208 LINEAR QUADRATIC GAUSSIAN CONTROL Reduced-order compensation - LOG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 Improving stability margins in discrete-time LOG controllers LINEAR QUADRATIC REGULATOR An analytical and experimental investigation of output feedback vs. linear quadratic regulator for large space structures [AIAA PAPER 87-2390] p 61 A87-50474 Linear quadratic control system design for Space Station pointed payloads [AIAA PAPER 87-2530] p 161 A87-50533 Improving stability margins in discrete-time LOG controllers  LINEAR SYSTEMS  Maximum likelihood identification using an array processor [SAE PAPER 861790] p 5 A87-32121 MOVER II - A computer program for verifying reduced-order models of large dynamic systems [SAE PAPER 861790] p 5 A87-32639 An identification method for flexible structures [AIAA PAPER 87-0745] p 16 A87-33669 Stability of time varying linear systems	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft p 26 N87-20361  Notes on implementation of Coulomb friction in coupled dynamical simulations p 67 N87-22746  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures spacecraft masts [NASA-CR-180317]  LOCAL AREA NETWORKS  Star topology spacecraft data bus p 112 A87-37431  GLOBECOM '86 - Global Telecommunications Conference, Houston, TX, Dec. 1-4, 1986, Conference Record. Volumes 1, 2, & 3 p 169 A87-45476  Advanced local area network concepts p 117 N87-29153 Network reliability p 117 N87-29157  LOCKS (FASTENERS) Collect lock joint for space station truss [NASA-CASE-MSC-21207-1] Attitude control of a spacecraft using an extended self-organizing fuzzy logic controller p 59 A87-41617  LOGISTICS Space Shuttle flight rates and utilization p 1 A87-37963  LONG DURATION SPACE FLIGHT A question of gravity p 1 A87-32116 Space Station personal hygiene study [SAE PAPER 860931] Life Support Subsystem concepts for botanical experiments of long duration
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 88 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117 LIGHT EMITTING DIODES Head-ported display analysis for Space Station applications p 111 A87-31463 LINEAR PROGRAMMING Optimization of a program of experiments in connection with the operational planning of studies carried out with a spacecraft p 148 A87-34208 LINEAR QUADRATIC GAUSSIAN CONTROL Reduced-order compensation - LOG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 Improving stability margins in discrete-time LOG controllers p 31 N87-22719 LINEAR QUADRATIC REGULATOR An analytical and experimental investigation of output feedback vs. linear quadratic regulator for large space structures [AIAA PAPER 87-2390] p 61 A87-50474 Linear quadratic control system design for Space Station pointed payloads [AIAA PAPER 87-2530] p 161 A87-50533 Improving stability margins in discrete-time LOG controllers p 31 N87-22719 LINEAR SYSTEMS Maximum likelihood identification using an array processor p 5 A87-32121 MOVER II - A computer program for verifying reduced-order models of large dynamic systems [SAE PAPER 861790] p 5 A87-32639 An identification method for flexible structures [AIAA PAPER 87-0745] p 5 A87-32699 Stability of time varying linear systems [ASME PAPER 87-APM-341] p 59 A87-42505	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction  p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft  p 26 N87-20361  Notes on implementation of Coulomb friction in coupled dynamical simulations  p 67 N87-22746  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  LIFE (DURABILITY)  Design study of large area 8 cm x 8 cm wrapthrough cells for space station p 80 N87-26424  LIFE CYCLE COSTS  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  LIFE SCIENCES  Gas and water recycling system for IOC vivarium experiments Initial Operational Capacity p 46 A87-32457  Space Station - Opportunities for the life sciences p 122 A87-34871  Special considerations in outfitting a space station module for scientific use [SAE PAPER 860956] p 164 A87-38741  Conceptual planning for Space Station life sciences human research project [SAE PAPER 860959] p 164 A87-38751  Life Sciences Research Facility automation requirements and concepts for the Space Station [SAE PAPER 860970] p 50 A87-38752  Life Science Research Facility materials management requirements and concepts [SAE PAPER 860971] p 124 A87-38756  Soviet space stations as analogs, second edition [NASA-CR-180920] p 157 N87-21996  LIFE SUPPORT SYSTEMS  Preliminary experimental study on the oxygen separating and concentrating system for CELSS p 46 A87-32455  Development of carbon dioxide removal system - Experimental study of regenerable carbon dioxide removal and oxygen recovery system for the Space Station program Electrochemical Carbon Dioxide Concentration [SAE PAPER 860918] p 118 A87-38710  A Space Station utility - Static Feed Electrolyzer	[MBB-UR-E-907-86-PUB] p 154 A87-49967 Maintenance evaluation for space station liquid systems p 52 N87-21155 Hydrogen/oxygen economy for the space station p 8 N87-26130 Automated Subsystem Control for Life Support System (ASCLSS) [NASA-CR-172003] p 53 N87-29117 LIGHT EMITTING DIODES Head-ported display analysis for Space Station applications p 111 A87-31463 LINEAR PROGRAMMING Optimization of a program of experiments in connection with the operational planning of studies carried out with a spacecraft p 148 A87-34208 LINEAR QUADRATIC GAUSSIAN CONTROL Reduced-order compensation - LOG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 Improving stability margins in discrete-time LOG controllers LINEAR QUADRATIC REGULATOR An analytical and experimental investigation of output feedback vs. linear quadratic regulator for large space structures [AIAA PAPER 87-2390] p 61 A87-50474 Linear quadratic control system design for Space Station pointed payloads [AIAA PAPER 87-2530] p 161 A87-50533 Improving stability margins in discrete-time LOG controllers  LINEAR SYSTEMS  Maximum likelihood identification using an array processor p 5 A87-32121 MOVER II - A computer program for verifying reduced-order models of large dynamic systems [SAE PAPER 861790] p 5 A87-32639 An identification method for flexible structures [AIAA PAPER 87-0745] p 16 A87-33669 Stability of time varying linear systems	LOAD DISTRIBUTION (FORCES)  Modeling of controlled flexible structures with impulsive loads  LOADING MOMENTS  Structural dynamics system model reduction p 32 N87-22727  LOADS (FORCES)  Structural qualification of large spacecraft p 26 N87-20361  Notes on implementation of Coulomb friction in coupled dynamical simulations p 67 N87-22746  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures spacecraft masts [NASA-CR-180317]  LOCAL AREA NETWORKS  Star topology spacecraft data bus p 112 A87-37431  GLOBECOM '86 - Global Telecommunications Conference, Houston, TX, Dec. 1-4, 1986, Conference Record. Volumes 1, 2, & 3 p 169 A87-45476  Advanced local area network concepts p 117 N87-29153  Network reliability p 117 N87-29157  LOCKS (FASTENERS) Collect lock joint for space station truss [NASA-CASE-MSC-21207-1] p 36 N87-25576  LOGIC CIRCUITS Attitude control of a spacecraft using an extended self-organizing fuzzy logic controller p 59 A87-41617  LOGISTICS Space Shuttle flight rates and utilization p 1 A87-37963  LONG DURATION SPACE FLIGHT A question of gravity p 1 A87-32116 Space Station personal hygiene study [SAE PAPER 860937] p 49 A87-38749  Maintenance components for Space Station long life

Space Station environmental control and life support system distribution and loop closure studies [SAE PAPER 860942] p 48 A87-38729

	Autonomous decentralized system concept for Space	Evaluation of constraint stabilization procedures for
science and technology Russian book	Station p 146 A87-32541	multibody dynamical systems
p 151 A87-40342	MAINTENANCE	[AIAA PAPÉR 87-0927] p 7 A87-33728
Life support subsystem concepts for botanical experiments of long duration	Advanced EVA system design requirements study:	Development of harmonic drive actuator for space
[MBB-UR-E-907-86-PUB] p 154 A87-49967	EVAS/space station system interface requirements [NASA-CR-171981] p 120 N87-20351	manipulator p 149 A87-35076
Space station experiment definition: Long term cryogenic	[NASA-CR-171981] p 120 N87-20351 Maintenance evaluation for space station liquid	Control of robot manipulator compliance
fluid storage p 94 N87-21144	systems p 52 N87-21155	p 100 A87-45797
Radiation shielding requirements on long-duration space	MAN ENVIRONMENT INTERACTIONS	Application of a traction-drive 7-degrees-of-freedom
missions	Human factors standards for space habitation	telerobot to space manipulation
[AD-A177512] p 140 N87-21991	p 162 A87-33022	[DE87-004616] p 101 N87-22231
Soviet space stations as analogs, second edition	Effect of crew motions on the spatial position of a	Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233
[NASA-CR-180920] p 157 N87-21996	spacecraft p 152 A87-41954 MAN MACHINE SYSTEMS	Total of the state
Effect of long-term exposure to Low Earth Orbit (LEO)	A master-slave manipulator system for space use	Telerobotic technology for nuclear and space applications
space environment p 142 N87-26207	p 147 A87-32546	[NASA-CR-180923] p 102 N87-22242
LONG TERM EFFECTS	Role of the manned maneuvering unit for the Space	Developing a voice-controlled, computer-generated
Development of an emulation-simulation thermal control	Station	display to assist space station astronauts during
model for space station application	[SAE PAPER 861834] p 133 A87-32667	maintenance activity
[NASA-CR-180312] p 45 N87-26936	Human factors standards for space habitation	[AD-A178997] p 120 N87-22762
LONGERONS Model study of simpley master for any service of simpley master.	p 162 A87-33022	End effector development study. Volume 2: Service End
Model study of simplex masts for space applications p 144 A87-32339	Aerospace environmental systems; Proceedings of the	Effector subsystem specification (SEESSPEC)
applications p 144 A87-32339  Design consideration of mechanical and deployment	Sixteenth Intersociety Conference on Environmental	in-orbiting servicing
properties of a collable lattice mast p 12 A87-32340	Systems, San Diego, CA, July 14-16, 1986 [SAE P-177] p.162 A87-38701	[FOK-TR-R-86-091-VOL-2] p 102 N87-24486
A Lanczos eigenvalue method on a parallel computer	[SAE P-177] p 162 A87-38701 The development of an EVA Universal Work Station	End effector development study, volume 1 in-orbit
for large complex space structure free vibration	[SAE PAPER 860952] p 164 A87-38739	servicing
analysis	An evaluation of advanced extravehicular crew	[FOK-TR-R-86-091-VOL-1] p 102 N87-25336
[AIAA PAPER 87-0725] p 13 A87-33565	enclosures	End effector development study. Volume 3: Appendices in-orbit servicing
Deployable geodesic truss structure	[SAE PAPER 861009] p 134 A87-38781	[FOK-TR-R-86-091-VOL-3] p 102 N87-25337
[NASA-CASE-LAR-13113-1] p 36 N87-25492	Space Station EVA using a maneuvering enclosure	Self-calibration strategies for robot manipulators
LOW DENSITY MATERIALS	unit	p 102 N87-26355
Carbon fibre slotted waveguide arrays	[SAE PAPER 861010] p 135 A87-38782	The 21st Aerospace Mechanisms Symposium
p 85 A87-41302	Robotic telepresence p 100 A87-46704	[NASA-CP-2470] p 103 N87-29858
LOW FREQUENCIES	A multiple attribute decision analysis of manned airlock systems	Development of a standard connector for orbital
Low frequency vibration testing on satellites	[AD-A179241] p 137 N87-23682	replacement units for serviceable spacecraft
p 27 N87-20364 LOW GRAVITY MANUFACTURING	Automated Subsystem Control for Life Support System	p 40 N87-29864
Analytical and experimental modeling of zero/low gravity	(ASCLSS)	Telerobotic work system: Concept development and evolution n 104 N87-29866
fluid behavior	[NASA-CR-172003] p 53 N87-29117	evolution p 104 N87-29866 Traction-drive, seven-degree-of-freedom telerobot arm:
[AIAA PAPER 87-1865] p 91 A87-45260	Electronic control/display interface technology	A concept for manipulation in space p 104 N87-29867
Analytical determination of space station response to	p 88 N87-29161	MANNED MANEUVERING UNITS
crew motion and design of suspension system for	MAN-COMPUTER INTERFACE	Computer simulation of on-orbit manned maneuvering
microgravity experiments p 67 N87-22752	An evaluation of menu systems for Space Station interfaces p 111 A87-33040	unit operations
Progress in theory, technology of space materials	interfaces p 111 A87-33040 User interface design guidelines for expert	[SAE PAPER 861783] p 47 A87-32632
science p 158 N87-27695 LOW THRUST	troubleshooting systems for Space Station	Role of the manned maneuvering unit for the Space
Status and tendencies for low to medium thrust	p 6 A87-33050	Station (SAE BARES SOLOGIA)
propulsion systems	A hybrid nonlinear programming method for design	[SAE PAPER 861834] p 133 A87-32667
[IAF PAPER 86-162] p 90 A87-42680	optimization p 7 A87-35718	The next step for the MMU - Capabilities and enhancements
LUBRICATION SYSTEMS	Standards for the user interface - Developing a user	[SAE PAPER 861013] p 160 A87-38783
Space Station lubrication considerations	consensus for Space Station Information System	MANNED ORBITAL LABORATORIES
p 104 N87-29879	[AIAA PAPER 87-2209] p 169 A87-48594	The Industrial Space Facility p 167 A87-38579
LUMINESCENCE	TAE Plus: A conceptual view of TAE in the space station	System aspects of Columbus thermal control
The role of electronic mechanisms in surface erosion	era p 9 N87-23157	[SAE PAPER 860938] p 150 A87-38727
		Science and payload options for animal and plant
and glow phenomena p 137 N87-26181	SOT: A rapid prototype using TAE windows	part provide a provide to the arms and plant
Spacecraft ram glow and surface temperature	p 114 N87-23161	research accommodations aboard the early Space
	p 114 N87-23161 MANAGEMENT	research accommodations aboard the early Space Station
Spacecraft ram glow and surface temperature p 10 N87-26205	p 114 N87-23161  MANAGEMENT  Adaptive momentum management for large space	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740
Spacecraft ram glow and surface temperature	p 114 N87-23161  MANAGEMENT  Adaptive momentum management for large space structures	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview
Spacecraft ram glow and surface temperature p 10 N87-26205	p 114 N87-23161  MANAGEMENT Adaptive momentum management for large space structures [NASA-CR-179085] p 67 N87-22758	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview p 156 N87-20623
Spacecraft ram glow and surface temperature p 10 N87-26205  M  MACH-ZEHNDER INTERFEROMETERS	p 114 N87-23161  MANAGEMENT  Adaptive momentum management for large space structures [NASA-CR-179085] p 67 N87-22758  SAGA: A project to automate the management of	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview p 156 N87-20623 Military man in space: A history of Air Force efforts to find a manned space mission
Spacecraft ram glow and surface temperature p 10 N87-26205  M  MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures	p 114 N87-23161  MANAGEMENT Adaptive momentum management for large space structures [NASA-CR-179085] p 67 N87-22758 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview p 156 N87-20623 Military man in space: A history of Air Force efforts to find a manned space mission [AD-A179873] p 171 N87-25815
Spacecraft ram glow and surface temperature p 10 N87-26205  M  MACH-ZEHNDER INTERFEROMETERS	p 114 N87-23161  MANAGEMENT Adaptive momentum management for large space structures [NASA-CR-179085] p 67 N87-22758 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  MANAGEMENT ANALYSIS	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview p 156 N87-20623 Military man in space: A history of Air Force efforts to find a manned space mission [AD-A179873] p 171 N87-25815 Preliminary study of a Biological and Biochemical
Spacecraft ram glow and surface temperature p 10 N87-26205  M  MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures p 11 A87-31505  MAGNESIUM ALLOYS Material damping in aluminum and metal matrix	p 114 N87-23161  MANAGEMENT Adaptive momentum management for large space structures [NASA-CR-179085] p 67 N87-22758 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  MANAGEMENT ANALYSIS Innovations in space management - Macromanagement	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview p 156 N87-20623 Military man in space: A history of Air Force efforts to find a manned space mission [AD-A179873] p 171 N87-25815 Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive
Spacecraft ram glow and surface temperature p 10 N87-26205  M  MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures p 11 A87-31505  MAGNESIUM ALLOYS Material damping in aluminum and metal matrix composites p 106 A87-49797	p 114 N87-23161  MANAGEMENT Adaptive momentum management for large space structures [NASA-CR-179085] p 67 N87-22758 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  MANAGEMENT ANALYSIS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview p 156 N87-20623 Military man in space: A history of Air Force efforts to find a manned space mission [AD-A179873] p 171 N87-25815 Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive summary
Spacecraft ram glow and surface temperature p 10 N87-26205  M  MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures p 11 A87-31505  MAGNESIUM ALLOYS p 11 A87-31505  Material damping in aluminum and metal matrix composites p 106 A87-49797  MAGNETIC COOLING	p 114 N87-23161  MANAGEMENT Adaptive momentum management for large space structures [NASA-CR-179085] p 67 N87-22758 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  MANAGEMENT ANALYSIS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT METHODS	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview p 156 N87-20623 Military man in space: A history of Air Force efforts to find a manned space mission [AD-A179873] p 171 N87-25815 Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive
Spacecraft ram glow and surface temperature p 10 N87-26205  M  MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures p 11 A87-31505  MAGNESIUM ALLOYS Material damping in aluminum and metal matrix composites p 106 A87-49797  MAGNETIC COOLING Magnetic refrigeration for space platforms	p 114 N87-23161  MANAGEMENT  Adaptive momentum management for large space structures [NASA-CR-179085] p 67 N87-22758  SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  MANAGEMENT ANALYSIS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT METHODS Innovations in space management - Macromanagement	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview p 156 N87-20623 Military man in space: A history of Air Force efforts to find a manned space mission [AD-A179873] p 171 N87-25815 Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive summary [ESA-CR(P)-2338] p 158 N87-27698 MANNED SPACE FLIGHT A question of gravity p 1 A87-32116
Spacecraft ram glow and surface temperature p 10 N87-26205  M  MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures p 11 A87-31505  MAGNESIUM ALLOYS Material damping in aluminum and metal matrix composites composites p 106 A87-49797  MAGNETIC COOLING Magnetic refrigeration for space platforms [SAE PAPER 861724] p 118 A87-32613	p 114 N87-23161  MANAGEMENT Adaptive momentum management for large space structures [NASA-CR-179085] p 67 N87-22758 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  MANAGEMENT ANALYSIS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT METHODS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview p 156 N87-20623 Military man in space: A history of Air Force efforts to find a manned space mission [AD-A179873] p 171 N87-25815 Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive summary [ESA-CR(P)-2338] p 158 N87-27698 MANNED SPACE FLIGHT A question of gravity p 1 A87-32116 Prototype thermal bus for manned Space Station
Spacecraft ram glow and surface temperature p 10 N87-26205  M  MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures p 11 A87-31505  MAGNESIUM ALLOYS	p 114 N87-23161  MANAGEMENT Adaptive momentum management for large space structures [NASA-CR-179085] p 67 N87-22758 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  MANAGEMENT ANALYSIS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT METHODS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT SYSTEMS	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview p 156 N87-20623 Military man in space: A history of Air Force efforts to find a manned space mission [AD-A179873] p 171 N87-25815 Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive summary [ESA-CR(P)-2338] p 158 N87-27698 MANNED SPACE FLIGHT A question of gravity p 1 A87-32116 Prototype thermal bus for manned Space Station compartments
Spacecraft ram glow and surface temperature p 10 N87-26205  M  MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures p 11 A87-31505  MAGNESIUM ALLOYS Material damping in aluminum and metal matrix composites composites p 106 A87-49797  MAGNETIC COOLING Magnetic refrigeration for space platforms [SAE PAPER 861724] p 118 A87-32613	p 114 N87-23161  MANAGEMENT  Adaptive momentum management for large space structures [NASA-CR-179085] p 67 N87-22758  SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  MANAGEMENT ANALYSIS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT METHODS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT SYSTEMS  An operations management system for the Space	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview p 156 N87-20623 Military man in space: A history of Air Force efforts to find a manned space mission [AD-A179873] p 171 N87-25815 Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive summary [ESA-CR(P)-238] p 158 N87-27698 MANNED SPACE FLIGHT A question of gravity p 1 A87-32116 Prototype thermal bus for manned Space Station compartments [SAE PAPER 861825] p 41 A87-32668
Spacecraft ram glow and surface temperature p 10 N87-26205  M  MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures p 11 A87-31505  MAGNESIUM ALLOYS Material damping in aluminum and metal matrix composites p 106 A87-49797  MAGNETIC COOLING Magnetic refrigeration for space platforms [SAE PAPER 861724]  MAGNETIC FIELD CONFIGURATIONS A preliminary study of extended magnetic field structures	p 114 N87-23161  MANAGEMENT Adaptive momentum management for large space structures [NASA-CR-179085] p 67 N87-22758 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  MANAGEMENT ANALYSIS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT METHODS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT SYSTEMS An operations management system for the Space Station p 112 A87-40358	research accommodations aboard the early Space Station  [SAE PAPER 860953] p 164 A87-38740  The Columbus program: An overview p 156 N87-20623  Military man in space: A history of Air Force efforts to find a manned space mission  [AD-A179873] p 171 N87-25815  Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive summary  [ESA-CR(P)-2338] p 158 N87-27698  MANNED SPACE FLIGHT  A question of gravity p 1 A87-32116  Prototype thermal bus for manned Space Station compartments  [SAE PAPER 860825] p 41 A87-32668  Manned space flight comparisons between U.S. and
Spacecraft ram glow and surface temperature p 10 N87-26205  M  MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures p 11 A87-31505  MAGNESIUM ALLOYS Material damping in aluminum and metal matrix composites p 106 A87-49797  MAGNETIC COOLING Magnetic refrigeration for space platforms [SAE PAPER 861724] MAGNETIC FIELD CONFIGURATIONS A preliminary study of extended magnetic field structures in the ionosphere [NASA-CR-181004] p 140 N87-23066  MAGNETIC INDUCTION	MANAGEMENT Adaptive momentum management for large space structures [NASA-CR-179085] p 67 N87-22758 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412 MANAGEMENT ANALYSIS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870 MANAGEMENT METHODS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870 MANAGEMENT SYSTEMS An operations management system for the Space Station p 112 A87-40358 Communication and Data Management Systems for an	research accommodations aboard the early Space Station  [SAE PAPER 860953] p 164 A87-38740  The Columbus program: An overview p 156 N87-20623  Military man in space: A history of Air Force efforts to find a manned space mission  [AD-A179873] p 171 N87-25815  Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive summary  [ESA-CR(P)-2338] p 158 N87-27698  MANNED SPACE FLIGHT  A question of gravity p 1 A87-32116  Prototype thermal bus for manned Space Station compartments  [SAE PAPER 861825] p 41 A87-32668  Manned space flight comparisons between U.S. and U.S.S.P. programs p 167 A87-33019
Spacecraft ram glow and surface temperature p 10 N87-26205  M  MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures P 11 A87-31505  MAGNESIUM ALLOYS Material damping in aluminum and metal matrix composites P 106 A87-49797  MAGNETIC COOLING Magnetic refrigeration for space platforms [SAE PAPER 861724] P 118 A87-32613  MAGNETIC FIELD CONFIGURATIONS A preliminary study of extended magnetic field structures in the ionosphere [NASA-CR-181004] MAGNETIC INDUCTION Thermal and dynamical effects on electrodynamic space	MANAGEMENT  Adaptive momentum management for large space structures [NASA-CR-179085] p 67 N87-22758  SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  MANAGEMENT ANALYSIS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT METHODS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT SYSTEMS An operations management system for the Space Station  Communication and Data Management Systems for an orbiting platform p 112 A87-40359	research accommodations aboard the early Space Station  [SAE PAPER 860953] p 164 A87-38740  The Columbus program: An overview p 156 N87-20623  Military man in space: A history of Air Force efforts to find a manned space mission  [AD-A179873] p 171 N87-25815  Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive summary  [ESA-CR(P)-2338] p 158 N87-27698  MANNED SPACE FLIGHT  A question of gravity p 1 A87-32116  Prototype thermal bus for manned Space Station compartments  [SAE PAPER 861825] p 41 A87-32668  Manned space flight comparisons between U.S. and U.S.B. programs p 167 A87-33019  When the doctor is 200 miles away
Spacecraft ram glow and surface temperature p 10 N87-26205  M  MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures p 11 A87-31505  MAGNESIUM ALLOYS Material damping in aluminum and metal matrix composites p 106 A87-49797  MAGNETIC COOLING Magnetic refrigeration for space platforms [SAE PAPER 861724] p 118 A87-32613  MAGNETIC FIELD CONFIGURATIONS A preliminary study of extended magnetic field structures in the ionosphere [NASA-CR-181004] p 140 N87-23066  MAGNETIC INDUCTION Thermal and dynamical effects on electrodynamic space tethers	MANAGEMENT  Adaptive momentum management for large space structures [NASA-CR-179085] p 67 N87-22758  SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  MANAGEMENT ANALYSIS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT METHODS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT SYSTEMS  An operations management system for the Space Station p 112 A87-40358  Communication and Data Management Systems for an orbiting platform p 112 A87-40359  On board Data Management p 112 A87-40359	research accommodations aboard the early Space Station  [SAE PAPER 860953] p 164 A87-38740  The Columbus program: An overview p 156 N87-20623  Military man in space: A history of Air Force efforts to find a manned space mission  [AD-A179873] p 171 N87-25815  Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive summary  [ESA-CR(P)-238] p 158 N87-27698  MANNED SPACE FLIGHT  A question of gravity p 1 A87-32116  Prototype thermal bus for manned Space Station compartments  [SAE PAPER 861825] p 41 A87-32668  Manned space flight comparisons between U.S. and U.S.S.R. programs p 167 A87-33019  When the doctor is 200 miles away
Spacecraft ram glow and surface temperature p 10 N87-26205  M  MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures p 11 A87-31505  MAGNESIUM ALLOYS Material damping in aluminum and metal matrix composites p 106 A87-49797  MAGNETIC COOLING Magnetic refrigeration for space platforms [SAE PAPER 861724] MAGNETIC FIELD CONFIGURATIONS A preliminary study of extended magnetic field structures in the ionosphere [NASA-CR-181004] p 140 N87-23066  MAGNETIC INDUCTION Thermal and dynamical effects on electrodynamic space tethers [AD-A180276] p 130 N87-25351	MANAGEMENT  Adaptive momentum management for large space structures [NASA-CR-179085] p 67 N87-22758  SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  MANAGEMENT ANALYSIS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT METHODS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT SYSTEMS An operations management system for the Space Station  Communication and Data Management Systems for an orbiting platform p 112 A87-40359	research accommodations aboard the early Space Station  [SAE PAPER 860953] p 164 A87-38740  The Columbus program: An overview p 156 N87-20623  Military man in space: A history of Air Force efforts to find a manned space mission  [AD-A179873] p 171 N87-25815  Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive summary  [ESA-CR(P)-2338] p 158 N87-27698  MANNED SPACE FLIGHT  A question of gravity p 1 A87-32116  Prototype thermal bus for manned Space Station compartments  [SAE PAPER 861825] p 41 A87-32668  Manned space flight — comparisons between U.S. and U.S.B. programs p 167 A87-33019  When the doctor is 200 miles away  p 47 A87-35600  Mir in action p 150 A87-37971  Results on reuse of reclaimed shower water
MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures P 10 N87-26205  MAGNESIUM ALLOYS Material damping in aluminum and metal matrix composites P 106 A87-49797  MAGNETIC COOLING Magnetic refrigeration for space platforms [SAE PAPER 861724] P 118 A87-32613  MAGNETIC FIELD CONFIGURATIONS A preliminary study of extended magnetic field structures in the ionosphere [NASA-CR-181004] MAGNETIC INDUCTION Thermal and dynamical effects on electrodynamic space tethers [AD-A180276] P 130 N87-25351  MAGNETIC STORAGE	MANAGEMENT  Adaptive momentum management for large space structures [NASA-CR-179085] p 67 N87-22758  SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  MANAGEMENT ANALYSIS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT METHODS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT SYSTEMS  An operations management system for the Space Station Communication and Data Management Systems for an orbiting platform p 112 A87-40359 On board Data Management p 112 A87-40359 On board Data Management p 112 A87-40381 A comparison of scheduling algorithms for autonomous management of the Space Station electric energy system	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview p 156 N87-20623 Military man in space: A history of Air Force efforts to find a manned space mission [AD-A179873] p 171 N87-25815 Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive summary [ESA-CR(P)-2338] p 158 N87-27698 MANNED SPACE FLIGHT  A question of gravity p 1 A87-32116 Prototype thermal bus for manned Space Station compartments [SAE PAPER 861825] p 41 A87-32668 Manned space flight comparisons between U.S. and U.S.S.R. programs p 167 A87-33019 When the doctor is 200 miles away  P 47 A87-35600 Mir in action p 150 A87-37971 Results on reuse of reclaimed shower water [SAE PAPER 860983] p 50 A87-38762
Spacecraft ram glow and surface temperature p 10 N87-26205  M  MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures p 11 A87-31505  MAGNESIUM ALLOYS Material damping in aluminum and metal matrix composites p 106 A87-49797  MAGNETIC COOLING Magnetic refrigeration for space platforms [SAE PAPER 861724] MAGNETIC FIELD CONFIGURATIONS A preliminary study of extended magnetic field structures in the ionosphere [NASA-CR-181004] p 140 N87-23066  MAGNETIC INDUCTION Thermal and dynamical effects on electrodynamic space tethers [AD-A180276] p 130 N87-25351	MANAGEMENT Adaptive momentum management for large space structures [NASA-CR-179085] p 67 N87-22758 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412 MANAGEMENT ANALYSIS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870 MANAGEMENT METHODS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870 MANAGEMENT SYSTEMS An operations management system for the Space Station p 112 A87-40358 Communication and Data Management Systems for an orbiting platform p 112 A87-40359 On board Data Management p 112 A87-40351 A comparison of scheduling algorithms for autonomous management of the Space Station electric energy system [AIAA PAPER 87-2467] p 77 A87-50511	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview p 156 N87-20623 Military man in space: A history of Air Force efforts to find a manned space mission [AD-A179873] p 171 N87-25815 Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive summary [ESA-CR(P)-2338] p 158 N87-27698 MANNED SPACE FLIGHT A question of gravity p 1 A87-32116 Prototype thermal bus for manned Space Station compartments [SAE PAPER 861825] p 41 A87-32668 Manned space flight comparisons between U.S. and U.S.S.R. programs p 167 A87-33019 When the doctor is 200 miles away  Mir in action p 150 A87-37971 Results on reuse of reclaimed shower water [SAE PAPER 860983] p 50 A87-38762 Environmental control and life support technologies for
MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures P 10 N87-26205  MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures P 11 A87-31505  MAGNESIUM ALLOYS Material damping in aluminum and metal matrix composites P 10 A87-49797  MAGNETIC COOLING Magnetic refrigeration for space platforms [SAE PAPER 861724] P 118 A87-32613  MAGNETIC FIELD CONFIGURATIONS A preliminary study of extended magnetic field structures in the ionosphere [NASA-CR-181004] P 140 N87-23066  MAGNETIC INDUCTION Thermal and dynamical effects on electrodynamic space tethers [AD-A180276] P 130 N87-25351  MAGNETIC STORAGE Mass storage systems for data transport in the early space station era 1992-1998	MANAGEMENT  Adaptive momentum management for large space structures [NASA-CR-179085] p 67 N87-22758  SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  MANAGEMENT ANALYSIS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT METHODS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT SYSTEMS  An operations management system for the Space Station p 112 A87-40358  Communication and Data Management Systems for an orbiting platform p 112 A87-40359  On board Data Management p 112 A87-40381  A comparison of scheduling algorithms for autonomous management of the Space Station electric energy system [AIAA PAPER 87-2467] p 77 A87-50511  MANEUVERABLE SPACECRAFT	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview p 156 N87-20623 Military man in space: A history of Air Force efforts to find a manned space mission [AD-A179873] p 171 N87-25815 Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive summary [ESA-CR(P)-2338] p 158 N87-27698 MANNED SPACE FLIGHT A question of gravity p 1 A87-32116 Prototype thermal bus for manned Space Station compartments [SAE PAPER 861825] p 41 A87-32668 Manned space flight comparisons between U.S. and U.S.S.R. programs p 167 A87-33019 When the doctor is 200 miles away  Mir in action p 150 A87-37971 Results on reuse of reclaimed shower water [SAE PAPER 860983] p 50 A87-38762 Environmental control and life support technologies for advanced manned space missions
MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures P 10 N87-26205  MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures P 11 A87-31505  MAGNESIUM ALLOYS Material damping in aluminum and metal matrix composites P 106 A87-49797  MAGNETIC COOLING Magnetic refrigeration for space platforms [SAE PAPER 861724] P 118 A87-32613  MAGNETIC FIELD CONFIGURATIONS A preliminary study of extended magnetic field structures in the ionosphere [NASA-CR-181004] P 140 N87-23066  MAGNETIC INDUCTION Thermal and dynamical effects on electrodynamic space tethers [AD-A180276] P 130 N87-25351  MAGNETIC STORAGE Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] MAGNETIC STORMS	MANAGEMENT  Adaptive momentum management for large space structures [NASA-CR-179085] p 67 N87-22758  SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  MANAGEMENT ANALYSIS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT METHODS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT SYSTEMS An operations management system for the Space Station p 112 A87-40358  Communication and Data Management Systems for an orbiting platform p 112 A87-40359 On board Data Management p 112 A87-40359 On board Data Management p 112 A87-40351 A comparison of scheduling algorithms for autonomous management of the Space Station electric energy system [AIAA PAPER 87-2467]  MANEUVERABLE SPACECRAFT A quantitative comparison of several orbital maneuvering	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview p 156 N87-20623 Military man in space: A history of Air Force efforts to find a manned space mission [AD-A179873] p 171 N87-25815 Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive summary [ESA-CR(P)-2338] p 158 N87-27698 MANNED SPACE FLIGHT  A question of gravity p 1 A87-32116 Prototype thermal bus for manned Space Station compartments [SAE PAPER 861825] p 41 A87-32668 Manned space flight comparisons between U.S. and U.S.S.R. programs p 167 A87-33019 When the doctor is 200 miles away  Manned space flight comparisons between U.S. and U.S.S.R. programs p 167 A87-33019 When the doctor is 200 miles away  P 47 A87-35600 Mir in action p 150 A87-37971 Results on reuse of reclaimed shower water [SAE PAPER 860983] p 50 A87-38762 Environmental control and life support technologies for advanced manned space missions [SAE PAPER 860994] p 51 A87-38771
MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures  MAGNESIUM ALLOYS  MAGNESIUM ALLOYS  Material damping in aluminum and metal matrix composites p 106 A87-49797  MAGNETIC COOLING  Magnetic refrigeration for space platforms [SAE PAPER 861724] p 118 A87-32613  MAGNETIC FIELD CONFIGURATIONS  A preliminary study of extended magnetic field structures in the ionosphere [INASA-CR-181004] p 140 N87-23066  MAGNETIC INDUCTION  Thermal and dynamical effects on electrodynamic space tethers [AD-A180276] p 130 N87-25351  MAGNETIC STORAGE  Mass storage systems for data transport in the early space station era 1992-1998 [INASA-TM-87826] p 115 N87-27443  MAGNETIC STORMS  Modeling of environmentally induced transients within	MANAGEMENT Adaptive momentum management for large space structures [NASA-CR-179085] p 67 N87-22758 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412 MANAGEMENT ANALYSIS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870 MANAGEMENT METHODS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870 MANAGEMENT METHODS Innovations in space management system for the Space Station p 112 A87-40358 Communication and Data Management Systems for an orbiting platform p 112 A87-40359 On board Data Management p 112 A87-40381 A comparison of scheduling algorithms for autonomous management of the Space Station electric energy system [AIAA PAPER 87-2467] p 77 A87-50511 MANEUVERABLE SPACECRAFT A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview p 156 N87-20623 Military man in space: A history of Air Force efforts to find a manned space mission [AD-A179873] p 171 N87-25815 Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive summary [ESA-CR(P)-2338] p 158 N87-27698 MANNED SPACE FLIGHT  A question of gravity p 1 A87-32116 Prototype thermal bus for manned Space Station compartments [SAE PAPER 861825] p 41 A87-32668 Manned space flight comparisons between U.S. and U.S.S.R. programs p 167 A87-33019 When the doctor is 200 miles away when the doctor is 200 miles away p 47 A87-35600 Mir in action p 150 A87-37971 Results on reuse of reclaimed shower water [SAE PAPER 860983] p 50 A87-38762 Environmental control and life support technologies for advanced manned space missions [SAE PAPER 860984] p 51 A87-38771 Integrated waste and water management system
MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures P 10 N87-26205  MAGNESIUM ALLOYS Material damping in aluminum and metal matrix composites P 106 A87-49797  MAGNETIC COOLING Magnetic refrigeration for space platforms [SAE PAPER 861724] P 118 A87-32613  MAGNETIC FIELD CONFIGURATIONS A preliminary study of extended magnetic field structures in the ionosphere [NASA-CR-181004] MAGNETIC INDUCTION Thermal and dynamical effects on electrodynamic space tethers [AD-A180276] P 130 N87-25351  MAGNETIC STORAGE Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826]  MAGNETIC STORMS Modeling of environmentally induced transients within satellities	MANAGEMENT  Adaptive momentum management for large space structures  [NASA-CR-179085] p 67 N87-22758  SAGA: A project to automate the management of software production systems  [NASA-CR-180276] p 10 N87-27412  MANAGEMENT ANALYSIS  Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT METHODS  Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT SYSTEMS  An operations management system for the Space Station p 112 A87-40358  Communication and Data Management Systems for an orbiting platform p 112 A87-40358  Communication and Data Management p 112 A87-40358  Comparison of scheduling algorithms for autonomous management of the Space Station electric energy system  [AIAA PAPER 87-2467] p 77 A87-50511  MANEUVERABLE SPACECRAFT  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview p 156 N87-20623 Military man in space: A history of Air Force efforts to find a manned space mission [AD-A179873] p 171 N87-25815 Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive summary [ESA-CR(P)-2338] p 158 N87-27698 MANNED SPACE FLIGHT A question of gravity p 1 A87-32116 Prototype thermal bus for manned Space Station compartments [SAE PAPER 861825] p 41 A87-32668 Manned space flight comparisons between U.S. and U.S.S.R. programs p 167 A87-33019 When the doctor is 200 miles away p 47 A87-35600 Mir in action p 150 A87-3971 Results on reuse of reclaimed shower water [SAE PAPER 860983] p 50 A87-38771 Results on reuse of reclaimed shower water [SAE PAPER 860994] p 51 A87-38771 Integrated waste and water management system [SAE PAPER 860996] p 51 A87-38773
MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures P 10 N87-26205  MAGNESIUM ALLOYS Magnesic refrigeration for space platforms [SAE PAPER 861724] MAGNETIC COOLING Magnetic refrigeration for space platforms [SAE PAPER 861724] P 118 A87-32613  MAGNETIC FIELD CONFIGURATIONS A preliminary study of extended magnetic field structures in the ionosphere [NASA-CR-181004] MAGNETIC INDUCTION Thermal and dynamical effects on electrodynamic space tethers [AD-A180276] MAGNETIC STORAGE Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] MAGNETIC STORMS Modeling of environmentally induced transients within satellites [AIAA PAPER 85-0387] D 7 A87-41611	MANAGEMENT  Adaptive momentum management for large space structures [NASA-CR-179085] p 67 N87-22758  SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  MANAGEMENT ANALYSIS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT METHODS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT SYSTEMS An operations management system for the Space Station p 112 A87-40358  Communication and Data Management Systems for an orbiting platform p 112 A87-40359  On board Data Management p 112 A87-40351  A comparison of scheduling algorithms for autonomous management of the Space Station electric energy system [AIAA PAPER 87-2467] p 77 A87-50511  MANEUVERABLE SPACECRAFT A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment (AD-A179106) p 161 N87-23677	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview p 156 N87-20623 Military man in space: A history of Air Force efforts to find a manned space mission [AD-A179873] p 171 N87-25815 Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive summary [ESA-CR(P)-2338] p 158 N87-27698 MANNED SPACE FLIGHT A question of gravity p 1 A87-32116 Prototype thermal bus for manned Space Station compartments [SAE PAPER 861825] p 41 A87-32668 Manned space flight — comparisons between U.S. and U.S.B. programs p 167 A87-39019 When the doctor is 200 miles away p 47 A87-35600 Mir in action p 150 A87-37971 Results on reuse of reclaimed shower water [SAE PAPER 860983] p 50 A87-38762 Environmental control and life support technologies for advanced manned space missions [SAE PAPER 860994] p 51 A87-38771 Integrated waste and water management system [SAE PAPER 8609996] p 51 A87-38773 An improved waste collection system for space flight
MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures P 10 N87-26205  MAGNESIUM ALLOYS Material damping in aluminum and metal matrix composites P 10 A87-49797  MAGNETIC COOLING Magnetic refrigeration for space platforms [SAE PAPER 861724] P 118 A87-32613  MAGNETIC FIELD CONFIGURATIONS A preliminary study of extended magnetic field structures in the ionosphere [NASA-CR-181004] P 140 N87-23066  MAGNETIC INDUCTION Thermal and dynamical effects on electrodynamic space tethers [AD-A180276] P 130 N87-25351  MAGNETIC STORAGE Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] P 115 N87-27443  MAGNETIC STORMS Modeling of environmentally induced transients within satellites [AIAA PAPER 85-0387] P 7 A87-41611  MAGNETOSPHERIC ELECTRON DENSITY	MANAGEMENT  Adaptive momentum management for large space structures [NASA-CR-179085] p 67 N87-22758  SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  MANAGEMENT ANALYSIS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT METHODS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT SYSTEMS An operations management system for the Space Station p 112 A87-40358  Communication and Data Management Systems for an orbiting platform p 112 A87-40359  On board Data Management p 112 A87-40359 On board Data Management p 112 A87-40391 A comparison of scheduling algorithms for autonomous management of the Space Station electric energy system [AIAA PAPER 87-2467] p 77 A87-50511  MANEUVERABLE SPACECRAFT A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  MANEUVERS Lanczos modes for reduced-order control of flexible	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview p 156 N87-20623 Military man in space: A history of Air Force efforts to find a manned space mission [AD-A179873] p 171 N87-25815 Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive summary [ESA-CR(P)-2338] p 158 N87-27698 MANNED SPACE FLIGHT  A question of gravity p 1 A87-32116 Prototype thermal bus for manned Space Station compartments [SAE PAPER 861825] p 41 A87-32668 Manned space flight comparisons between U.S. and U.S.S.R. programs p 167 A87-33019 When the doctor is 200 miles away  Manned space flight comparisons between U.S. and U.S.S.R. programs p 167 A87-39019 When the doctor is 200 miles away  P 47 A87-35600 Mir in action p 150 A87-37971 Results on reuse of reclaimed shower water [SAE PAPER 860983] p 50 A87-38762 Environmental control and life support technologies for advanced manned space missions [SAE PAPER 860994] p 51 A87-38771 Integrated waste and water management system [SAE PAPER 860996] A67-38773 An improved waste collection system for space flight
MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures P 10 N87-26205  MAGNESIUM ALLOYS Material damping in aluminum and metal matrix composites P 116 A87-49797  MAGNETIC COOLING Magnetic refrigeration for space platforms [SAE PAPER 861724] P 118 A87-32613  MAGNETIC FIELD CONFIGURATIONS A preliminary study of extended magnetic field structures in the ionosphere [NASA-CR-181004] MAGNETIC INDUCTION Thermal and dynamical effects on electrodynamic space tethers [AD-A180276] P 130 N87-25351  MAGNETIC STORAGE Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] P 115 N87-27443  MAGNETIC STORMS Modeling of environmentally induced transients within satellites [AIAA PAPER 85-0387]  MAGNETOSPHERIC ELECTRON DENSITY Thick dielectric charging on high altitude spacecraft	MANAGEMENT  Adaptive momentum management for large space structures  [NASA-CR-179085] p 67 N87-22758  SAGA: A project to automate the management of software production systems  [NASA-CR-180276] p 10 N87-27412  MANAGEMENT ANALYSIS  Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT METHODS  Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT SYSTEMS  An operations management system for the Space Station p 112 A87-40358  Communication and Data Management Systems for an orbiting platform p 112 A87-40359  On board Data Management p 112 A87-40381  A comparison of scheduling algorithms for autonomous management of the Space Station electric energy system  [AIAA PAPER 87-2467] p 77 A87-50511  MANEUVERABLE SPACECRAFT  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  MANEUVERS  Lanczos modes for reduced-order control of flexible structures p 33 N87-22739	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview p 156 N87-20623 Military man in space: A history of Air Force efforts to find a manned space mission [AD-A179873] p 171 N87-25815 Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive summary [ESA-CR(P)-2338] p 158 N87-27698 MANNED SPACE FLIGHT  A question of gravity p 1 A87-32116 Prototype thermal bus for manned Space Station compartments [SAE PAPER 861825] p 41 A87-32668 Manned space flight comparisons between U.S. and U.S.S.R. programs p 167 A87-39019 When the doctor is 200 miles away  Manned space flight comparisons between U.S. and U.S.S.R. programs p 167 A87-39019 When the doctor is 200 miles away  P 47 A87-35600 Mir in action p 150 A87-37971 Results on reuse of reclaimed shower water [SAE PAPER 860983] p 50 A87-38762 Environmental control and life support technologies for advanced manned space missions [SAE PAPER 860994] p 51 A87-38771 Integrated waste and water management system [SAE PAPER 860996] p 51 A87-38773 An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784 Europe prepares for manned orbited operations p 151 A87-39594
MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures P 10 A87-26205  MAGNESIUM ALLOYS Magnesium ALLOYS Magnetic damping in aluminum and metal matrix composites P 10 A87-49797  MAGNETIC COOLING Magnetic refrigeration for space platforms [SAE PAPER 861724] P 118 A87-32613  MAGNETIC FIELD CONFIGURATIONS A preliminary study of extended magnetic field structures in the ionosphere [NASA-CR-181004] P 140 N87-23066  MAGNETIC INDUCTION Thermal and dynamical effects on electrodynamic space tethers [AD-A180276] MAGNETIC STORAGE Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] MAGNETIC STORMS Modeling of environmentally induced transients within satellities [AIAA PAPER 85-0387] P 7 A87-41611  MAGNETOSPHERIC ELECTRON DENSITY Thick dielectric charging on high altitude spacecraft D 87 N87-26961	MANAGEMENT  Adaptive momentum management for large space structures  [NASA-CR-179085] p 67 N87-22758  SAGA: A project to automate the management of software production systems  [NASA-CR-180276] p 10 N87-27412  MANAGEMENT ANALYSIS  Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT METHODS  Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT SYSTEMS  An operations management system for the Space Station p 112 A87-40358  Communication and Data Management Systems for an orbiting platform p 112 A87-40359  On board Data Management p 112 A87-40381  A comparison of scheduling algorithms for autonomous management of the Space Station electric energy system [AIAA PAPER 87-2467] p 77 A87-50511  MANEUVERABLE SPACECRAFT  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  MANEUVERS  Lanczos modes for reduced-order control of flexible structures p 33 N87-22739  MANIPULATORS	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview p 156 N87-20623 Military man in space: A history of Air Force efforts to find a manned space mission [AD-A179873] p 171 N87-25815 Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive summary [ESA-CR(P)-2338] p 158 N87-27698 MANNED SPACE FLIGHT  A question of gravity p 1 A87-32116 Prototype thermal bus for manned Space Station compartments [SAE PAPER 861825] p 41 A87-32668 Manned space flight comparisons between U.S. and U.S.S.R. programs p 167 A87-33019 When the doctor is 200 miles away p 47 A87-35600 Mir in action p 150 A87-37971 Results on reuse of reclaimed shower water [SAE PAPER 860983] p 50 A87-38762 Environmental control and life support technologies for advanced manned space missions [SAE PAPER 860994] p 51 A87-38771 Integrated waste and water management system [SAE PAPER 860996] p 51 A87-38773 An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784 Europe prepares for manned orbited operations p 151 A87-38794 Legal problems concerning manned space flight
MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures P 10 N87-26205  MAGNESIUM ALLOYS Material damping in aluminum and metal matrix composites P 106 A87-49797  MAGNETIC COOLING Magnetic refrigeration for space platforms [SAE PAPER 861724] P 118 A87-32613  MAGNETIC FIELD CONFIGURATIONS A preliminary study of extended magnetic field structures in the ionosphere [NASA-CR-181004] MAGNETIC INDUCTION Thermal and dynamical effects on electrodynamic space tethers [AD-A180276] P 130 N87-25351  MAGNETIC STORAGE Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] P 115 N87-27443  MAGNETIC STORMS Modeling of environmentally induced transients within satellites [AIAA PAPER 85-0387]  MAGNETOSPHERIC ELECTRON DENSITY Thick dielectric charging on high altitude spacecraft P 87 N87-26961	MANAGEMENT  Adaptive momentum management for large space structures  [NASA-CR-179085] p 67 N87-22758  SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  MANAGEMENT ANALYSIS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT METHODS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT SYSTEMS An operations management system for the Space Station p 112 A87-40358  Communication and Data Management Systems for an orbiting platform p 112 A87-40359  On board Data Management p 112 A87-40359  On board Data Management p 112 A87-40381 A comparison of scheduling algorithms for autonomous management of the Space Station electric energy system  [AIAA PAPER 87-2467] p 77 A87-50511  MANEUVERABLE SPACECRAFT A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment (AD-A179106) p 161 N87-23677  MANEUVERS  Lanczos modes for reduced-order control of flexible structures p 33 N87-22739  MANIPULATORS Control of a flexible space manipulator	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview p 156 N87-20623 Military man in space: A history of Air Force efforts to find a manned space mission [AD-A179873] p 171 N87-25815 Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive summary [ESA-CR(P)-2338] p 158 N87-27698 MANNED SPACE FLIGHT A question of gravity p 1 A87-32116 Prototype thermal bus for manned Space Station compartments [SAE PAPER 861825] p 41 A87-32668 Manned space flight comparisons between U.S. and U.S.S.P. programs p 167 A87-33019 When the doctor is 200 miles away  Mir in action p 150 A87-37971 Results on reuse of reclaimed shower water [SAE PAPER 860983] p 50 A87-38762 Environmental control and life support technologies for advanced manned space missions [SAE PAPER 860996] p 51 A87-38771 Integrated waste and water management system [SAE PAPER 860996] p 51 A87-38773 An improved waste collection system for space flight [SAE PAPER 860996] p 151 A87-38784 Europe prepares for manned orbited operations p 151 A87-39594 Legal problems concerning manned space flight Russian book p 151 A87-40339
MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures P 10 N87-26205  MAGNESIUM ALLOYS MAGNESIUM ALLOYS MAGNESIUM ALLOYS MAGNETIC COOLING MAGNETIC COOLING MAGNETIC COOLING MAGNETIC FIELD CONFIGURATIONS A preliminary study of extended magnetic field structures in the ionosphere [NASA-CR-181004] MAGNETIC INDUCTION Thermal and dynamical effects on electrodynamic space tethers [AD-A180276] MAGNETIC STORAGE Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TH-87826] MAGNETIC STORMS MOdeling of environmentally induced transients within satellites [AIAA PAPER 85-0387] MAGNETIC STORMS MOdeling of environmentally induced transients within satellites [AIAA PAPER 85-0387] MAGNETOSPHERIC ELECTRON DENSITY Thick dielectric charging on high altitude spacecraft p 87 N87-26961  MAGNETOSPHERIC INSTABILITY The use of Pi2 pulsations as indicators of substorm effects at geostationary orbit p 142 N87-26942	MANAGEMENT  Adaptive momentum management for large space structures  [NASA-CR-179085] p 67 N87-22758  SAGA: A project to automate the management of software production systems  [NASA-CR-180276] p 10 N87-27412  MANAGEMENT ANALYSIS  Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT METHODS  Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT SYSTEMS  An operations management system for the Space Station p 112 A87-40358  Communication and Data Management Systems for an orbiting platform p 112 A87-40359  On board Data Management p 112 A87-40381  A comparison of scheduling algorithms for autonomous management of the Space Station electric energy system  [AIAA PAPER 87-2467] p 77 A87-50511  MANEUVERABLE SPACECRAFT  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  MANEUVERS  Lanczos modes for reduced-order control of flexible structures p 33 N87-22739  MANIPULATORS  Control of a flexible space manipulator  p 99 A87-32449	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview p 156 N87-20623 Military man in space: A history of Air Force efforts to find a manned space mission [AD-A179873] p 171 N87-25815 Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive summary [ESA-CR(P)-2338] p 158 N87-27698 MANNED SPACE FLIGHT A question of gravity p 1 A87-32116 Prototype thermal bus for manned Space Station compartments [SAE PAPER 861825] p 41 A87-32166 Manned space flight comparisons between U.S. and U.S.S.R. programs p 167 A87-33019 When the doctor is 200 miles away  Mir in action p 150 A87-3971 Results on reuse of reclaimed shower water [SAE PAPER 860983] p 50 A87-38762 Environmental control and life support technologies for advanced manned space missions [SAE PAPER 860994] p 51 A87-38771 Integrated waste and water management system [SAE PAPER 860996] p 51 A87-38773 An improved waste collection system for space flight Equal problems concerning manned space flight Russian book p 151 A87-3039 Priorities and policy analysis - A response to Alex
MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures P 10 N87-26205  MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures P 11 A87-31505  MAGNESIUM ALLOYS Material damping in aluminum and metal matrix composites P 106 A87-49797  MAGNETIC COOLING Magnetic refrigeration for space platforms [SAE PAPER 861724] P 118 A87-32613  MAGNETIC FIELD CONFIGURATIONS A preliminary study of extended magnetic field structures in the ionosphere [NASA-CR-181004] P 140 N87-23066  MAGNETIC INDUCTION Thermal and dynamical effects on electrodynamic space tethers [AD-A180276] P 130 N87-25351  MAGNETIC STORAGE Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] MAGNETIC STORMS Modeling of environmentally induced transients within satellites [AIAA PAPER 85-0387] P 7 A87-41611  MAGNETOSPHERIC ELECTRON DENSITY Thick dielectric charging on high altitude spacecraft P 87 N87-26961  MAGNETOSPHERIC INSTABILITY The use of PI2 pulsations as indicators of substorm effects at geostationary orbit P 142 N87-26942  MAINTAINABILITY  MAINTAINABILITY  MAINTAINABILITY	MANAGEMENT  Adaptive momentum management for large space structures  [NASA-CR-179085] p 67 N87-22758  SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  MANAGEMENT ANALYSIS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT METHODS Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT SYSTEMS An operations management system for the Space Station p 112 A87-40358  Communication and Data Management Systems for an orbiting platform p 112 A87-40359  On board Data Management p 112 A87-40359  On board Data Management p 112 A87-40381 A comparison of scheduling algorithms for autonomous management of the Space Station electric energy system  [AIAA PAPER 87-2467] p 77 A87-50511  MANEUVERABLE SPACECRAFT A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment (AD-A179106) p 161 N87-23677  MANEUVERS  Lanczos modes for reduced-order control of flexible structures p 33 N87-22739  MANIPULATORS Control of a flexible space manipulator	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview p 156 N87-20623 Military man in space: A history of Air Force efforts to find a manned space mission [AD-A179873] p 171 N87-25815 Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive summary [ESA-CR(P)-2338] p 158 N87-27698 MANNED SPACE FLIGHT  A question of gravity p 1 A87-32116 Prototype thermal bus for manned Space Station compartments [SAE PAPER 861825] p 41 A87-32668 Manned space flight comparisons between U.S. and U.S.S.R. programs p 167 A87-33019 When the doctor is 200 miles away p 47 A87-35600 Mir in action p 150 A87-37971 Results on reuse of reclaimed shower water [SAE PAPER 860983] p 50 A87-38762 Environmental control and life support technologies for advanced manned space missions [SAE PAPER 860994] p 51 A87-38771 Integrated waste and water management system [SAE PAPER 860994] p 51 A87-38778 An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784 Europe prepares for manned orbited operations p 151 A87-39594 Legal problems concerning manned space flight Russian book p 151 A87-40339 Priorities and policy analysis - A response to Alex Roland p 168 A87-41222
MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures P 10 N87-26205  MAGNESIUM ALLOYS Material damping in aluminum and metal matrix composites P 10 A87-49797  MAGNETIC COOLING Magnetic refrigeration for space platforms [SAE PAPER 861724] MAGNETIC FIELD CONFIGURATIONS A preliminary study of extended magnetic field structures in the ionosphere [NASA-CR-181004] MAGNETIC INDUCTION Thermal and dynamical effects on electrodynamic space tethers [AD-A180276] MAGNETIC STORAGE Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] MAGNETIC STORMS Modeling of environmentally induced transients within satellites [AIAA PAPER 85-0387] MAGNETIC STORMS MOdeling of environmentally induced transients within satellites [AIAA PAPER 85-0387] MAGNETOSPHERIC ELECTRON DENSITY Thick dielectric charging on high altitude spacecraft p 87 N87-26961  MAGNETOSPHERIC ELECTRON person of substorm effects at geostationary orbit p 142 N87-26942 MAINTAINABILITY Space Station integration and verification concepts	MANAGEMENT  Adaptive momentum management for large space structures  [NASA-CR-179085] p 67 N87-22758  SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  MANAGEMENT ANALYSIS  Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT METHODS  Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT SYSTEMS  An operations management system for the Space Station p 112 A87-40358  Communication and Data Management Systems for an orbiting platform p 112 A87-40359  On board Data Management p 112 A87-40381  A comparison of scheduling algorithms for autonomous management of the Space Station electric energy system [AIAA PAPER 87-2467] p 77 A87-50511  MANEUVERABLE SPACECRAFT  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  MANEUVERS  Lanczos modes for reduced-order control of flexible structures p 33 N87-22739  MANIPULATORS  Control of a flexible space manipulator p 99 A87-32449  Study of actuator for large space manipulator arm	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview p 156 N87-20623 Military man in space: A history of Air Force efforts to find a manned space mission [AD-A179873] p 171 N87-25815 Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive summary [ESA-CR(P)-2338] p 158 N87-27698 MANNED SPACE FLIGHT A question of gravity p 1 A87-32116 Prototype thermal bus for manned Space Station compartments [SAE PAPER 861825] p 41 A87-32668 Manned space flight comparisons between U.S. and U.S.S.B. programs p 167 A87-33019 When the doctor is 200 miles away  Mir in action p 150 A87-37971 Results on reuse of reclaimed shower water [SAE PAPER 860983] p 50 A87-38762 Environmental control and life support technologies for advanced manned space missions [SAE PAPER 860996] p 51 A87-38771 Integrated waste and water management system [SAE PAPER 860996] p 51 A87-38773 An improved waste collection system for space flight Russian book p 151 A87-39594 Legal problems concerning manned space flight Russian book p 151 A87-40339 Priorities and policy analysis - A response to Alex Roland p 188 A87-41222 Man's role in space exploration and exploitation
MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures P 10 N87-26205  MACH-ZEHNDER INTERFEROMETERS Fiber-optic monitors for space structures P 11 A87-31505  MAGNESIUM ALLOYS Material damping in aluminum and metal matrix composites P 106 A87-49797  MAGNETIC COOLING Magnetic refrigeration for space platforms [SAE PAPER 861724] P 118 A87-32613  MAGNETIC FIELD CONFIGURATIONS A preliminary study of extended magnetic field structures in the ionosphere [NASA-CR-181004] P 140 N87-23066  MAGNETIC INDUCTION Thermal and dynamical effects on electrodynamic space tethers [AD-A180276] P 130 N87-25351  MAGNETIC STORAGE Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] MAGNETIC STORMS Modeling of environmentally induced transients within satellites [AIAA PAPER 85-0387] P 7 A87-41611  MAGNETOSPHERIC ELECTRON DENSITY Thick dielectric charging on high altitude spacecraft P 87 N87-26961  MAGNETOSPHERIC INSTABILITY The use of PI2 pulsations as indicators of substorm effects at geostationary orbit P 142 N87-26942  MAINTAINABILITY  MAINTAINABILITY  MAINTAINABILITY	MANAGEMENT  Adaptive momentum management for large space structures  [NASA-CR-179085] p 67 N87-22758  SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  MANAGEMENT ANALYSIS  Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT METHODS  Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870  MANAGEMENT SYSTEMS  An operations management system for the Space Station p 112 A87-40358  Communication and Data Management Systems for an orbiting platform p 112 A87-40359  On board Data Management p 112 A87-40381  A comparison of scheduling algorithms for autonomous management of the Space Station electric energy system  [AIAA PAPER 87-2467] p 77 A87-50511  MANEUVERABLE SPACECRAFT  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  MANEUVERS  Lanczos modes for reduced-order control of flexible structures p 33 N87-22739  MANIPULATORS  Control of a flexible space manipulator arm p 99 A87-32449  Study of actuator for large space manipulator arm p 12 A87-32545	research accommodations aboard the early Space Station [SAE PAPER 860953] p 164 A87-38740 The Columbus program: An overview p 156 N87-20623 Military man in space: A history of Air Force efforts to find a manned space mission [AD-A179873] p 171 N87-25815 Preliminary study of a Biological and Biochemical Analysis Facility (BBAF) for Columbus: Executive summary [ESA-CR(P)-2338] p 158 N87-27698 MANNED SPACE FLIGHT  A question of gravity p 1 A87-32116 Prototype thermal bus for manned Space Station compartments [SAE PAPER 861825] p 41 A87-32668 Manned space flight comparisons between U.S. and U.S.S.R. programs p 167 A87-33019 When the doctor is 200 miles away p 47 A87-35600 Mir in action p 150 A87-37971 Results on reuse of reclaimed shower water [SAE PAPER 860983] p 50 A87-38762 Environmental control and life support technologies for advanced manned space missions [SAE PAPER 860994] p 51 A87-38771 Integrated waste and water management system [SAE PAPER 860994] p 51 A87-38771 An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784 Europe prepares for manned orbited operations p 151 A87-39594 Legal problems concerning manned space flight Russian book p 151 A87-303 Priorities and policy analysis - A response to Alex Roland p 168 A87-41222

Radiation environments and absorbed dose estimations	Modal test and analysis: Multiple tests concept for	Mobile remote manipulator vehicle system
on manned space missions p 139 A87-49026	improved validation of large space structure mathematical	[NASA-CASE-LAR-13393-1] p 103 N87-29118 Traction-drive, seven-degree-of-freedom telerobot arm:
The human quest in space; Proceedings of the	models p 8 N87-20581  Numerical modelling of cryogenic propellant behavior	A concept for manipulaton in space p 104 N87-29867
Twenty-fourth Goddard Memorial Symposium, Greenbelt, MD. Mar. 20, 21, 1986 p 2 A87-53082	in low-G p 95 N87-21148	Experiences of CNES and SEP on space mechanisms
Human capabilities in space	Investigation of plasma contactors for use with orbiting	rotating at low speed p 104 N87-29868 Common drive unit p 104 N87-29869
[AAS PAPER 86-114] p 165 A87-53089	wires	MECHANICAL PROPERTIES
Space biology and medicine on the twenty-fifth	[NASA-CR-180922] p 129 N87-22509 Identification of large space structures: A	Composite space antenna structures - Properties and
anniversary of the first spaceflight of Yuriy Alekseyevich Gagarin p 157 N87-20732	Identification of large space structures: A state-of-practice report p 31 N87-22705	environmental effects p 20 A87-38610
National Aeronautics and Space Administration	A general method for dynamic analysis of structures	PEEK (Polyether ether ketone) with 30 percent of carbon fibres for injection molding p 22 A87-44588
Authorization Act, fiscal year 1988	overview p 31 N87-22707	MECHANICS (PHYSICS)
[H-REPT-100-204] p 171 N87-25024	Verification of flexible structures by ground test	U.S. National Congress of Applied Mechanics, 10th,
USSR Report: Space [JPRS-USP-86-004] p 158 N87-27687	p 31 N87-22713	University of Texas, Austin, June 16-20, 1986,
MANNED SPACECRAFT	A quasi-analytical method for non-iterative computation of nonlinear controls p 66 N87-22731	Proceedings [AD-A181962] p 1 A87-40051
Manned spacecraft electrical power systems	Control of flexible structures and the research	MEDICAL EQUIPMENT
p 75 A87-37291 Manned spacecraft automation and robotics	community p 66 N87-22732	When the doctor is 200 miles away
p 100 A87-37300	Lanczos modes for reduced-order control of flexible	p 47 A87-35600 MELTS (CRYSTAL GROWTH)
Flunking on Space Station cooperation?	structures p 33 N87-22739	Progress in theory, technology of space materials
p 150 A87-37964	Maximum Entropy/Optimal Projection (MEOP) control design synthesis: Optimal quantification of the major design	science p 158 N87-27695
Military space station implications [AD-A180831] p 172 N87-26964	tradeoffs p 9 N87-22741	MENTAL PERFORMANCE
MANY BODY PROBLEM	Modeling of controlled flexible structures with impulsive	Workshop on Workload and Training, and Examination of their Interactions: Executive summary
Dynamics of a multibody system with relative translation	loads p 33 N87-22745 On the control of structures by applied thermal	[NASA-TM-89459] p 171 N87-25760
on curved, flexible tracks p 58 A87-40867 Global treatment of energy dissipation effects for	gradients p 33 N87-22747	METAL FILMS
multibody satellites p 62 A87-51610	Experimental characterization of deployable trusses and	Effects on advanced materials: Results of the STS-8
High speed simulation of flexible multibody dynamics	joints p 33 N87-22749	EOIM (Effects of Oxygen Interaction with Materials) experiment
p 33 N87-22738	System identification for large space structure damage assessment p 33 N87-22750	[AD-A182931] p 110 N87-29709
MARITIME SATELLITES  The INMARSAT solar array: The first Advanced Rigid	assessment p 33 N87-22750 Space station structures and dynamics test program	METAL MATRIX COMPOSITES
Array (ARA) to fly p 82 N87-28975	p 33 N87-22751	Material damping in aluminum and metal matrix composites p 106 A87-49797
MASS	Space station structural dynamics/reaction control	composites p 106 A87-49797  Development of metal matrix composites in R & D
Mass property estimation for control of asymmetrical satellites p 63 A87-52968	system interaction study p 67 N87-22753 Moving-bank multiple model adaptive estimation applied	Institute of Metals & Composites for Future Industries
satellites p 63 A87-52968  MASS DISTRIBUTION	to flexible spacestructure control	p 107 A87-51772
Optimization of payload mass placement in a dual keel	[AD-A178870] p 68 N87-22761	METAL OXIDES Oxidation protection coatings for polymers
space station	An analysis of space station motion subject to the	[NASA-CASE-LEW-14072-3] p 107 N87-23736
[NASA-TM-89051] p 68 N87-23687  MASS FLOW RATE	parametric excitation of periodic elevator motion [AD-A179235] p 68 N87-23681	METAL PLATES
The liquid droplet radiator in space: A parametric	Large spacecraft pointing and shape control	Design of an advanced two-phase capillary cold plate [SAF PAPER 861829] p 41 A87-32663
approach	p 69 N87-24498	[SAE PAPER 861829] p 41 A87-32663 Enhanced evaporative surface for two-phase mounting
[AD-A182605] p 46 N87-29217	Application of physical parameter identification to finite-element models p 34 N87-24505	plates
MASS SPECTROMETERS  Material interactions with the Low Earth Orbital (LEO)	Evaluation of on-line pulse control for vibration	[SAE PAPER 860979] p 42 A87-38760
environment: Accurate reaction rate measurements	suppression in flexible spacecraft	METAL SURFACES On the possibility of a several-kilovolt differential charge
p 108 N87-26175	[NASA-CR-180391] p 70 N87-24513	in the day sector of a geosynchronous orbit
Mass spectrometers and atomic oxygen p 141 N87-26176	Contact dynamics math model [NASA-CR-179147] p 71 N87-25801	p 158 N87-26953
MASS TRANSFER	Minimum time attitude slewing maneuvers of a rigid	METEORITIC DAMAGE
Progress in theory, technology of space materials	spacecraft	Expected size of a crater resulting from the impact of a micrometeorite p 119 A87-41870
science p 158 N87-27695	[NASA-CR-181130] p 72 N87-26038  Development of an emulation-simulation thermal control	Micrometeorite impact on solar panels ESA
MATERIALS HANDLING Life Science Research Facility materials management	model for space station application	telecommunication satellites p 82 N87-28981
requirements and concepts	[NASA-CR-181221] p 45 N87-27702	Micrometeorite exposure of solar arrays p 82 N87-28982
[SAE PAPER 860974] p 124 A87-38756	Thermal-electrical dynamical simulation of spacecraft	METEOROLOGICAL RADAR
An evaluation of candidate oxidation resistant materials	solar array p 83 N87-29004 Vibrations and structureborne noise in space station	Observation of precipitation from space by the weather
for space applications in LEO [NASA-TM-100122] p 107 N87-25480	[NASA-CR-181381] p 39 N87-29590	radar p 145 A87-32507
MATERIALS TESTS	Space Electrochemical Research and Technology	MICROCRACKS Assessment of space environment induced
A space debris simulation facility for spacecraft materials	(SERT) [NASA-CP-2484] p 5 N87-29914	microdamage in toughened composite materials
evaluation p 11 A87-32058	[NASA-CP-2484] p 5 N87-29914  MATRICES (MATHEMATICS)	p 20 A87-38609
The Vanderbilt University neutral O-beam facility p 105 A87-32059	New time-domain identification technique for vibrating	Microcrack resistant structural composite tubes for space applications p 106 A87-41022
Selected materials issues associated with Space	structures p 58 A87-40869	space applications p 106 A87-41022  MICROGRAVITY APPLICATIONS
Station p 105 A87-32061	Projection filters for modal parameter estimate for flexible structures	On the dynamical stability of the space 'monorail'
A high flux pulsed source of energetic atomic oxygen	[NASA-CR-180303] p 38 N87-26583	p 148 A87-34047
for spacecraft materials ground testing	MATRIX MATERIALS	Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573
p 139 A87-38623 Materials for space applications p 106 A87-44741	Material damping in aluminum and metal matrix composites p 106 A87-49797	Symposium on Microgravity Fluid Mechanics,
Materials for space applications p 106 A87-44741 Testing of materials for solar power space	composites p 106 A87-49797 MATRIX METHODS	Proceedings of the Winter Annual Meeting, Anaheim, CA,
applications p 107 A87-53946	Wave propagation in periodic truss structures	Dec. 7-12, 1986 p 89 A87-38785
MATHEMATICAL MODELS	[AIAA PAPER 87-0944] p 18 A87-33742	A three-mass tethered system for micro-g/variable-g applications p 125 A87-40859
An assessment of recent advances in modeling and	Comparison of the Craig-Bampton and residual flexibility methods of substructure representation	Japanese Experiment Module (JEM) preliminary design
control design of space structures under uncertainty [SAE PAPER 861818] p 147 A87-32655	p 19 A87-34510	status p 151 A87-41570
An identification method for flexible structures	MAXIMUM ENTROPY METHOD	Analytical and experimental modeling of zero/low gravity
[AIAA PAPER 87-0745] p 16 A87-33669	Maximum Entropy/Optimal Projection (MEOP) control design synthesis: Optimal quantification of the major design	fluid behavior [AIAA PAPER 87-1865] p 91 A87-45260
System identification of a truss type space structure	tradeoffs p 9 N87-22741	[AIAA PAPER 87-1865] p 91 A87-45260 Scientific user requirements for microgravity research
using the multiple boundary condition test (MBCT)	MAXIMUM LIKELIHOOD ESTIMATES	(European aspects)
method [AIAA PAPER 87-0746] p 16 A87-33670	Maximum likelihood identification using an array	[AIAA PAPER 87-2195] p 153 A87-48581
A formulation for studying dynamics of N connected	processor p 5 A87-32121 Maximum likelihood parameter identification of flexible	Microgravity experiments onboard Eureca
flexible deployable members p 21 A87-41574	spacecraft	p 155 A87-53554
Modeling and control of torsional vibrations in a flexible	[ETN-87-90235] p 38 N87-27705	MICROMETEORITES  Expected size of a crater resulting from the impact of
structure p 60 A87-50033	MECHANICAL DEVICES	a micrometeorite p 119 A87-41870
Dynamic and thermal effects in very large space structures p 25 N87-20347	Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic and	MICROMETEOROIDS
Spacecraft qualification using advanced vibration and	circulatory forces p 22 A87-47812	Micrometeorite impact on solar panels ESA
modal testing techniques p 27 N87-20368	AUTOLIANO AL DENVEO	telecommunication satellites p 82 N87-28981
	MECHANICAL DRIVES	
Modeling and control of flexible structures p 28 N87-20564	Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233	Micrometeorite exposure of solar arrays p 82 N87-28982

of large space structures [AIAA PAPER 87-0903]

[AlAA PAPER 87-0903] p 17 A87-33712 Modal analyses of dynamics of a deformable multibody spacecraft - The Space Station: A continuum approach [AlAA PAPER 87-0925] p 17 A87-33727

MICROPROCESSORS	The design and analysis of passive damping for	MOTION SICKNESS
Microprocessor controlled proof-mass actuator p 65 N87-22706	aerospace systems [AIAA PAPER 87-0891] p 58 A87-39644	Space motion sickness status report [SAE PAPER 860923] p 163 A87-38714
MICROWAVE ANTENNAS	A laboratory simulation of flexible spacecraft control	An analysis of space station motion subject to the
Design of a beacon receiving system for the Olympus satellite p 86 A87-50157	[AIAA PAPER 87-2325] p 24 A87-50446 Distributed parameter modeling of the structural	parametric excitation of periodic elevator motion [AD-A179235] p 68 N87-23681
MICROWAVE TRANSMISSION	dynamics of the Solar Array Flight Experiment	[AD-A179235] p 68 N87-23681  MOTION SIMULATION
Shape control of the directional pattern in a	[AIAA PAPER 87-2460] p 25 A87-50506	High speed simulation of multi-flexible-body systems
microwave-beam power transmission channel p 148 A87-34345	Practical issues in computation of optimal, distributed control of flexible structures	with large rotations
MILITARY OPERATIONS	[AIAA PAPER 87-2461] p 25 A87-50507	[AIAA PAPER 87-0930] p 57 A87-33730  On the inadequacies of current multi-flexible body
Present and future military uses of outer space:	Dynamic qualification of spacecraft by means of modal synthesis p 26 N87-20363	simulation codes
International law, politics, and the practice of states [AD-A176722] p 170 N87-21753	Structural dynamics system model reduction	[AIAA PAPER 87-2248] p 7 A87-50412
Military space station implications	p 32 N87-22727	Contact dynamics math model [NASA-CR-179147] p 71 N87-25801
[AD-A180831] p 172 N87-26964	MODEL REFERENCE ADAPTIVE CONTROL  An Al-based model-adaptive approach to flexible	MOTORS
AILITARY SPACECRAFT	structure control	Common drive unit p 104 N87-29869 MOUNTING
The benefit of phase change thermal storage for spacecraft thermal management	[AIAA PAPER 87-2457] p 61 A87-50503	Soft mounted momentum compensated pointing system
[AIAA PAPER 87-1482] p 43 A87-43014	Model reference adaptive control for large structural systems p 63 A87-52973	for the Space Shuttle Orbiter p 59 A87-42817
Toward the year 2000: The near future of the American	MODELS	MULTIBEAM ANTENNAS  Thermal deformation and electrical degradation of
civilian and military space programs [DE87-006467] p 171 N87-22697	Preliminary performance characterizations of an	antenna reflector with truss backstructure
Military space station implications	engineering model multipropellant resistojet for space station application	p 12 A87-32405
[AD-A180831] p 172 N87-26964	[AIAA PAPER 87-2120] p 93 A87-50197	Multiple beam phased array for Space Station Control Zone Communications p 85 A87-45519
MILITARY TECHNOLOGY	Modeling of joints for the dynamic analysis of truss	Zone Communications p 85 A87-45519 On-board K- and S-band multi-beam antennas
1987 status report - United States Air Force electric propulsion research and development	structures [NASA-TP-2661] p 28 N87-20567	p 86 A87-46281
[AIAA PAPER 87-1036] p 90 A87-41122	The results of a limited study of approaches to the	MULTIPATH TRANSMISSION  The effect of multipath on digital communications
Spacecraft environment interaction investigation	design, fabrication, and testing of a dynamic model of the	systems: With application to space station
[AD-A179183] p 140 N87-23678	NASA IOC space station. Executive summary [NASA-CR-178276] p 8 N87-21020	[AD-A178578] p 86 N87-22876
Optimal trajectories for aeroassisted, coplanar orbital	Modeling and control of flexible structures	MULTIPLE ACCESS  Multiple Access Ku-band communications subsystem for
transfer p 54 A87-31681	[AD-A177106] p 29 N87-21388	the Space Station p 84 A87-31462
IIR SPACE STATION	A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet	Multiple beam phased array for Space Station Control
Mir - A second Sputnik? p 153 A87-46872 USSR Report: Space	[NASA-TM-89854] p 96 N87-22237	Zone Communications p 85 A87-45519
[JPRS-USP-86-004] p 158 N87-27687	Preliminary performance characterizations of an	Antenna systems and RF coverage for the Space Station p.2 A87-45523
Pravda commentary, photos of Mir orbital station	engineering model multipropellant resistojet for space station application	Space Station multiple access communications
p 158 N87-27688	[NASA-TM-100113] p 96 N87-23821	system p 86 A87-45524 MULTIPLEXING
HRRORS Design considerations for long-lived glass mirrors for	Preliminary design, analysis, and costing of a dynamic	Fiber optics wavelength division
space p 123 A87-36531	scale model of the NASA space station [NASA-CR-4068] p 36 N87-25606	multiplexing(components) p 117 N87-29151
Optical correlator use at Johnson Space Center	Modeling and computational algorithms for parameter	MULTISPECTRAL BAND SCANNERS  The Radarsat Modular Opto-electronic Multispectral
p 59 A87-42655	estimation and optimal control of aeroelastic systems and	Scanner (R-MOMS): A potential candidate for the Polar
Control of multiple-mirror/flexible-structures in slew maneuvers	large flexible structures [AD-A183302] p 11 N87-29893	Orbiting Platform (POP) also
[AIAA PAPER 87-2324] p 24 A87-50445	MODULATION	[MBB-UR-873/86] p 130 N87-25506 MUSCULAR STRENGTH
ISSION PLANNING Hubble Space Telescope satellite servicing	Potential modulations on SCATHA (Spacecraft Charging	Space suit reach and strength envelope
[SAE PAPER 861796] p 133 A87-32644	At High Altitude) spacecraft [AD-A176815] p 140 N87-21024	considerations
Nuclear powered submarines and the Space Station -	MODULES	[SAE PAPER 860950] p 49 A87-38737
A comparison of ECLSS requirements [SAE PAPER 860945] p 48 A87-38732	Conceptual design and integration of a Space Station	N
Europe prepares for manned orbited operations	resistojet propulsion assembly [AIAA PAPER 87-1860] p 91 A87-45256	N
p 151 A87-39594	[AlAA PAPER 87-1860] p 91 A87-45256 Conceptual design and integration of a space station	NASA PROGRAMS
Columbus/Space Station United Kingdom Utilisation Study 1985/6 Report - Executive Summary	resistojet propulsion assembly	Flunking on Space Station cooperation?
p 151 A87-41429	[NASA-TM-89847] p 93 N87-20378	p 150 A87-37964 The Space Station overview p 168 A87-41571
Mission scheduling expert system and its space station	Fiber optics common transceiver module p 117 N8/-29160	USA-Europe coordination and cooperation activities:
applications [AIAA PAPER 87-2221] p 7 A87-48602	MOLECULAR CLOUDS	Announcements of Opportunity polar platforms
From Eureca-A to Eureca-B p 155 A87-53916	High energy gamma ray astronomy	p 170 N87-20632 Space operations: NASA's use of information
Satellite servicing mission preliminary cost estimation model	p 129 N87-24258 MOLECULAR COLLISIONS	technology. Report to the Chairman, Committee on
[NASA-CR-171978] p 136 N87-20335	External contamination environment of Space Station	Science, Space and Technology [GAO/IMTEC-87-20] p 137 N87-22551
An advanced technology space station for the year 2025,	Customer Servicing Facility	Department of Housing and Urban
study and concepts [NASA-CR-178208] p 120 N87-20340	[AIAA PAPER 87-1623] p 52 A87-43122 MOMENTS OF INERTIA	Development-independent agencies appropriations for
High power/large area PV systems	Adaptive momentum management for large space	1988 [GPO-73-418] p 171 N87-22560
p 80 N87-26452	structures	National Aeronautics and Space Administration
Phase 3 study of selected tether applications in space.  Volume 1: Executive summary	[NASA-CR-179085] p 67 N87-22758	Authorization Act
[NASA-CR-179185] p 131 N87-29585	An analysis of space station motion subject to the parametric excitation of periodic elevator motion	[S-REPT-100-87] p 171 N87-24240 National Aeronautics and Space Administration
LEO and GEO missions p 5 N87-29916  JPL future missions and energy storage technology	[AD-A179235] p 68 N87-23681	Authorization Act, fiscal year 1988
implications p 84 N87-29917	MOMENTUM	[H-REPT-100-204] p 171 N87-25024 National Aeronautics and Space Administration
IXING	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817	p 172 N87-30220
Mixing-induced fluid destratification and ullage condensation p 95 N87-21149	Adaptive momentum management for large space	NASA authorization: Authorization of appropriations for
condensation p 95 N87-21149  OBILITY	structures	the National Aeronautics and Space Administration for fiscal year 1988
Mobile remote manipulator vehicle system	[NASA-CR-179085] p 67 N87-22758 MOMENTUM TRANSFER	[GPO-73-245] p 172 N87-30221
[NASA-CASE-LAR-13393-1] p 103 N87-29118 <b>DDAL RESPONSE</b>	Optimal shuttle altitude changes using tethers	NASA SPACE PROGRAMS
Space structure vibration modes - How many exist?	[AD-A179205] p 129 N87-22756	Space research - At a crossroads p 166 A87-32017
Which ones are important? p 11 A87-32120	Distributed control using linear momentum exchange	NASA's space program - Space Station: A status report
Validation of large space structures by ground tests	devices [NASA-TM-100308] p 70 N87-24521	and a view of its value for space science
p 11 A87-32336 Spillover stabilization and decentralized modal control	Characterization and hardware modification of linear	p 1 A87-32277 The Space Station - Work Package 3
of large space structures	momentum exchange devices	p 118 A87-32529

momentum exchange devices [NASA-TM-86594]

Localization in disordered periodic structures

MONTE CARLO METHOD

[AIAA PAPER 87-0819]

p 70 N87-24723

p 19 A87-33757

p 118 A87-32529

National space transportation studies

[SAE PAPER 861681] p 160 A87-32598

Manned space flight — comparisons between U.S. and
U.S.S.R. programs p 167 A87-33019

Overview of the NASA automation and robotics research	NOISE	Nuclear propulsion systems for orbit transfer based on
program p 100 A87-33867 International cooperation in space	Guidelines for noise and vibration levels for the space station	the particle bed reactor
p 149 A87-34594	[NASA-CR-178310] p 120 N87-24162	[DE87-010060] p 99 N87-28405
Innovations in space management - Macromanagement	NONEQUILIBRIUM RADIATION	NUMERICAL ANALYSIS  Thermal and dynamical effects on electrodynamic space
and the NASA heritage p 167 A87-34870	Nonequilibrium radiation during re-entry at 10 km/s [AIAA PAPER 87-1543] p 135 A87-43060	tethers
A crisis in the NASA space and earth sciences programme p 112 A87-37968	[AIAA PAPER 87-1543] p 135 A87-43060 NONLINEAR PROGRAMMING	[AD-A180276] p 130 N87-25351
Concepts for the evolution of the Space Station	A hybrid nonlinear programming method for design	NUMERICAL CONTROL
Program	optimization p 7 A87-35718	Space Station propulsion system test bed and control system testing results
[SAE PAPER 860972] p 120 A87-38754 Environmental control and life support technologies for	NONLINEAR SYSTEMS	[AIAA PAPER 87-1858] p 91 A87-45255
advanced manned space missions	Nonlinear transient analysis of joint dominated structures	Robotic telepresence p 100 A87-46704
[SAE PAPER 860994] p 51 A87-38771	[AIAA PAPER 87-0892] p 17 A87-33709	NUMERICAL FLOW VISUALIZATION  Nonequilibrium radiation during re-entry at 10 km/s
Reconstituting the US space programme p 168 A87-41218	Incorporation of the effects of material damping and	[AIAA PAPER 87-1543] p 135 A87-43060
Priorities and policy analysis - A response to Alex	nonlinearities on the dynamics of space structures	NUMERICAL STABILITY
Roland p 168 A87-41222	p 21 A87-40075	Lanczos modes for reduced-order control of flexible
Mir - A second Sputnik? p 153 A87-46872	Robust nonlinear attitude control of flexible spacecraft p 60 A87-48273	structures p 33 N87-22739 NUTATION DAMPERS
We shouldn't build the Space Station now p 169 A87-46875	Variable structure control system maneuvering of	Variable structure controller design for spacecraft
The Space Station: A personal journey Book	spacecraft p 64 N87-21989	nutation damping p 58 A87-39958
p 169 A87-46975	Dynamics of trusses having nonlinear joints	NUTRITION Foods and nutrition in space
Scientific customer needs - NASA user [AIAA PAPER 87-2196] p 119 A87-48582	p 32 N87-22724 Suboptimal control of large flexible space structures	[SAE PAPER 860926] p 47 A87-38716
[AIAA PAPER 87-2196] p 119 A87-48582 Space Station - All change? p 154 A87-50792	experiencing rotational dynamics nonlinearities	( - · - · · · · - · · · · · · · · · · ·
Leadership in space transportation	[AD-A180606] p 71 N87-25352	0
p 170 A87-53989	Response of joint dominated space structures	•
Toward the year 2000: The near future of the American	[NASA-CR-180564] p 36 N87-26071	OCEAN DATA ACQUISITIONS SYSTEMS
civilian and military space programs [DE87-006467] p 171 N87-22697	Joint nonlinearity effects in the design of a flexible truss structure control system	Ocean-ice panel report International Space Station p 156 N87-20635
Control engineering tasks in the framework of the	[NASA-CR-180633] p 37 N87-26365	OCEAN SURFACE
Columbus program	Response of joint dominated space structures	An advanced wind scatterometer for the Columbus Polar
[MBB-UR-E-912/86] p 158 N87-26842	[NASA-CR-181202] p 37 N87-26397	Platform payload p 155 A87-53117
Data management system architecture options for space stations Columbus project	The effect of nonlinearities on flexible structures [AD-A181735] p 38 N87-27259	OCEANOGRAPHIC PARAMETERS  Computer simulation of a rotational single-element
[SES/DNP/TR/002/85] p 115 N87-28585	NONLINEARITY	flexible spacecraft boom
Study of data management system architecture options	Studies in nonlinear structural dynamics: Chaotic	[AD-A181798] p 103 N87-26968
for space station Columbus project	behavior and poynting effect p 26 N87-20348	ODORS Vapor fragrancer
[MATRA-RF/176/0932-ISS-1] p 115 N87-28586 Design of a mixed fleet transportation system to low	Dynamic finite element modeling of flexible structures [AD-A177168] p 30 N87-22252	[NASA-CASE-LAR-13680-1] p 165 N87-25561
Earth orbit. Volume 1: Executive summary. Volume 2:	Characterization and hardware modification of linear	OILS
Near-term shuttle replacement. Volume 3: Heavy-lift cargo	momentum exchange devices	Multi-axis vibration tests on spacecraft using hydraulic exciters p 8 N87-20373
vehicle. Volume 4: Advanced technology shuttle replacement p 5 N87-29583	[NASA-TM-86594] p 70 N87-24723	ON-LINE SYSTEMS
NASTRAN	NONUNIFORM PLASMAS Potential modulations on SCATHA (Spacecraft Charging	On-line identification and attitude control for SCOLE
Equivalent beam modeling using numerical reduction	At High Altitude) spacecraft	[AIAA PAPER 87-2459] p 61 A87-50505 ONBOARD DATA PROCESSING
techniques p 32 N87-22725	[AD-A176815] p 140 N87-21024	On board Data Management p 112 A87-4038
NAVSTAR SATELLITES Electric propulsion for orbit transfer - A NAVSTAR case	NOZZLE DESIGN Evaluation of carbon-carbon for space engine nozzle	Data management system architecture options for space
study (Has electric propulsion's time come?)	p 98 N87-26116	stations Columbus project [SES/DNP/TR/002/85] p 115 N87-28588
[AIAA PAPER 87-0985] p 88 A87-38001	NOZZLE FLOW	Proceedings: Computer Science and Data Systems
NEAR FIELDS Near-field testing of the 5-meter model of the tetrahedral	Effect of nozzle geometry on the resistojet exhaust	Technical Symposium, volume 1
truss antenna	plume [AIAA PAPER 87-2121] p 62 A87-52252	[NASA-TM-89285] p 116 N87-29124
[NASA-CR-178147] p 30 N87-21987	NOZZLE GEOMETRY	KSC Space Station Operations Language (SSOL) p 138 N87-2916
NETWORK CONTROL Network reliability p 117 N87-29157	Effect of nozzle geometry on the resistojet exhaust	ONBOARD EQUIPMENT
Network reliability p 117 N87-29157  NEUTRAL ATOMS	plume [AIAA PAPER 87-2121] p 62 A87-52252	Space Station data management system architecture
Neutral atomic oxygen beam produced by ion charge	NUCLEAR ELECTRIC POWER GENERATION	p 111 A87-3729
exchange for Low Earth Orbital (LEO) simulation	Nuclear reactor power for an electrically powered orbital	OPERATING COSTS Space Station EVA systems trade-off model
p 131 N87-26188  The production of low-energy neutral oxygen beams by	transfer vehicle [AIAA PAPER 87-1102] p 76 A87-41145	[SAE PAPER 860990] p 134 A87-3876
grazing-incidence neutralization p 131 N87-26191	[AIAA PAPER 87-1102] p 76 A87-41145 NUCLEAR ELECTRIC PROPULSION	A model for the estimation of the operations and
NEUTRAL BEAMS	ERATO orbital transfer vehicle with electronuclear power	utilisation costs of an international space station p 168 A87-4226
Production of a beam of ground state oxygen atoms	Study of the associated electronuclear generator	OPERATING SYSTEMS (COMPUTERS)
of selectable energy p 139 A87-38624	p 75 A87-36944 Performance of an SP-100/pulsed electrothermal	TAE Plus: A conceptual view of TAE in the space station
The production of low-energy neutral oxygen beams by grazing-incidence neutralization p 131 N87-26191	thruster orbit transfer vehicle	era p 9 N87-2315
Groundbased studies of spacecraft glow and erosion	[AIAA PAPER 87-2027] p 77 A87-45363	SOT: A rapid prototype using TAE windows p 114 N87-2316
caused by impact of oxygen and nitrogen beams	NUCLEAR ENGINE FOR ROCKET VEHICLES	Distributed computer taxonomy based on O/S
p 109 N87-26200	NERVA derived nuclear orbit transfer system [AIAA PAPER 87-2155] p 92 A87-45439	structure p 116 N87-2912
Martin Marietta atomic oxygen Low Earth Orbit (LEO) simulation p 142 N87-26204	NUCLEAR POWER PLANTS	SS focused technology: Gateways and NOS's
NEUTRAL BUOYANCY SIMULATION	Telerobotic technology for nuclear and space	p 117 N87-2916
Space Station EVA simulation demonstrates orbital	applications [NASA-CR-180923] p 102 N87-22242	Network operating system p 117 N87-2916 Network operating system focus technology
assembly p 132 A87-32006	NUCLEAR POWER REACTORS	p 117 N87-2916
NEUTRALIZERS  An analysis of bipropellant neutralization for spacecraft	Coaxial tube array space transmission line	KSC Space Station Operations Language (SSOL)
refueling operations p 97 N87-25888	characterization [NASA-TM-89864] p 96 N87-22003	p 138 N87-2916
NEUTRON STARS	Nuclear reactor power for a space-based radar. SP-100	OPERATIONS RESEARCH  A multiple attribute decision analysis of manned airlock
High energy gamma ray astronomy p 129 N87-24258	project	A multiple attribute decision analysis of manned alriocal systems
NICKEL HYDROGEN BATTERIES	[NASA-TM-89295] p 79 N87-25838 NUCLEAR POWERED SHIPS	[AD-A179241] p 137 N87-23682
Effect of component compression on the initial	Nuclear powered submarines and the Space Station -	Optimization of payload mass placement in a dual kee
performance of an IPV nickel-hydrogen cell	A comparison of ECLSS requirements	space station [NASA-TM-89051] p 68 N87-2368
[NASA-TM-100102] p 79 N87-24838	[SAE PAPER 860945] p 48 A87-38732	[NASA-TM-89051] p 68 N87-2368 Space Station end effector strategy study
Regenerative fuel cells for space applications p 84 N87-29938	NUCLEAR PROPULSION  Advanced propulsion activities in the USA	[NASA-TM-100488] p 103 N87-2959
NOAA SATELLITES	p 90 A87-41575	OPTICAL COMMUNICATION
Operational instruments on the Space Station-Polar	Nuclear propulsion systems for orbit transfer based on the particle bed reactor	Proof that timing requirements of the FDDI token ring protocol are satisfied — fiber distributed data interface
Platforms - Contributions by NOAA and the international	[DF87-010060] p 99 N87-28405	p 112 A87-4282

OPTICAL	DATA	STORAGE	MATERIALS

Mass storage systems for data transport in the early space station era 1992-1998

[NASA-TM-87826] p 115 N87-27443

**OPTICAL MEASURING INSTRUMENTS** 

Measuring thermal expansion in large composite structures --- for spaceborne telescopes

p 20 A87-38612

### OPTICAL TRACKING

Optical correlator use at Johnson Space Center p 59 A87-42655

OPTICS

Optical arrays for future astronomical telescopes in p 126 A87-44533

OPTIMAL CONTROL

Robust controller design using frequency domain p 11 A87-32229 Simultaneous structure/control optimization of large

flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610

Optimization procedure to control the coupling of vibration modes in flexible space structures

[AIAA PAPER 87-0826] p 14 A87-33613 A comparison of active vibration control techniques -Output feedback vs optimal control

[AIAA PAPER 87-0904] p 56 A87-33713 Structural and control optimization of space structures [AIAA PAPER 87-0939] p 17 A87-33737

Optimal vibration control by the use of piezoceramic

sensors and actuators [AIAA PAPER 87-0959] p 18 A87-33751 Gradient-based combined structural and control ontimization p 21 A87-40866

Combining space-based propulsive maneuvers and aerodynamic maneuvers to achieve optimal orbital

[AIAA PAPER 87-2567] p 93 A87-49617 Reduced-order compensation - LQG reduction versus

optimal projection
[AIAA PAPER 87-2388] p 61 A87-50472 A new concept of generalized structural filtering for

active vibration control synthesis [AIAA PAPER 87-2456] n 24 A87-50502 Practical issues in computation of optimal, distributed

control of flexible structures [AIAA PAPER 87-2461] p 25 A87-50507 Aeroassisted orbital maneuvering using Lyapunov

optimal feedback control [AIAA PAPER 87-2464] p.93 A87-50509 A comparison of scheduling algorithms for autonomous

management of the Space Station electric energy [AIAA PAPER 87-2467] p 77 A87-50511

Dynamic modeling and optimal control design for large flexible space structures p 26 N87-20358 OPUS: Optimal Projection for Uncertain Systems

[AD-A1768201 p 29 N87-21025 A quasi-analytical method for non-iterative computation of nonlinear controls p 66 N87-22731 Modified independent modal space control method for active control of flexible systems

[NASA-CR-181065] p 34 N87-23980 Minimum time attitude slewing maneuvers of a rigid spacecraft

[NASA-CR-181130] An investigation of methodology for the control and failure identification of flexible structures

p 38 N87-26921 The dynamics and control of large flexible space structures X, part 1

[NASA-CR-181287] Optimal nodal transfer and aeroassisted transfer by erocruise p 138 N87-28577

Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures

[AD-A183302] p 11 N87-29893 Optimum shape control of flexible beams by iezo-electric actuators

[NASA-CR-181413] p 40 N87-29898

# OPTIMIZATION

ASTROS - A multidisciplinary automated structural design tool

[AIAA PAPER 87-0713] p 6 A87-33557 Practical implementation of an accurate method for multilevel design sensitivity analysis

[AIAA PAPER 87-0718] p.6 A87-33560 Control augmented structural synthesis with transient response constraints

[AIAA PAPER 87-0749] p 56 A87-33573 Robustness optimization of structural and controller

[AIAA PAPER 87-0791] p 14 A87-33591 Integrated structural electromagnetic optimization of space antenna reflectors [AIAA PAPER 87-0824]

p 14 A87-33611

Optimal placement of excitations and sensors for verification of large dynamical systems

p 19 A87-33755 [AIAA PAPER 87-0782] Optimization of a program of experiments in connection with the operational planning of studies carried out with p 148 A87-34208 a spacecraft

An approach to structure/control simultaneous optimization for large flexible spacecraft

p 22 A87-46793 Optimization of aerospace structures subjected to random vibration and fatigue constraints

p 29 N87-20599 Equivalent beam modeling using numerical reduction p 32 N87-22725 An integrated, optimization-based approach to the

design and control of large space structures p 34 N87-23683

Shape design sensitivity analysis and optimal design of structural systems [NASA-CR-181095] p 37 N87-26370

Optimizing experimental programs in operational planning of research carried out from spacecraft p 160 N87-29553

#### **ORBIT PERTURBATION**

Instability of an elastic filament in orbit around a gravitating center p 148 A87-32815 Dynamic and thermal effects in very large space structures p 25 N87-20347

### **ORBIT TRANSFER VEHICLES**

A two-dimensional numerical heat transfer model for a solar propulsion system plar propulsion system p 74 A87-32306 System and operation analyses of OTV Network - A

new space transportation concept p 145 A87-32475 Commercial US transfer vehicle overview

[SAE PAPER 861764] p 1 A87-32625 ERATO orbital transfer vehicle with electronuclear power Study of the associated electronuclear generator

p 75 A87-36944 Electric propulsion for orbit transfer - A NAVSTAR case study (Has electric propulsion's time come?)

[AIAA PAPER 87-0985] p 88 A87-38001 Geosynchronous earth orbit base propulsion - Electric propulsion options

[AIAA PAPER 87-0990] D 89 A87-38004 Nuclear reactor power for an electrically powered orbital transfer vehicle

[AIAA PAPER 87-1102] p 76 A87-41145 Concepts for space maintenance of OTV engines

D 135 A87-41161 Evaluation of cryogenic system test options for the OTV on-orbit propellant depot [AIAA PAPER 87-1498]

p 90 A87-43027 Design parameters and environmental considerations for a reusable aeroassisted orbital transfer vehicle [AIAA PAPER 87-1505] p 160 A87-43031

Nonequilibrium radiation during re-entry at 10 km/s p 135 A87-43060 [AIAA PAPER 87-1543] Space-based OTV boiloff disposition

[AIAA PAPER 87-1767] p 91 A87-45191 Ariane transfer vehicle (ATV) to supply Space Station [AIAA PAPER 87-1862] p 152 A87-45257

Liquid propulsion technology for expendable and STS launch vehicle transfer stages [AIAA PAPER 87-1934] p 92 A87-45311

erformance of an SP-100/pulsed electrothermal thruster orbit transfer vehicle [AIAA PAPER 87-2027] p 77 A87-45363

Concepts for space maintenance of OTV engines p 136 A87-46000

Thermodynamic analysis and subscale modeling of space-based orbit transfer vehicle cryogenic propellant

[AIAA PAPER 87-1764] p 92 A87-48572

Synergetic plane-change capability of a conceptual aeromaneuvering-orbital-transfer vehicle [AIAA PAPER 87-2565] p 92 A87-49615 Combining space-based propulsive maneuvers and

aerodynamic maneuvers to achieve optimal orbital transfer

[AIAA PAPER 87-2567] p 93 A87-49617 Optimal heading change with minimum energy loss for

a hypersonic gliding vehicle [AIAA PAPER 87-2568] p 136 A87-49618 Temperature fields due to jet induced mixing in a typical

[AIAA PAPER 87-2017] Aero-Assisted Orbital Transfer Vehicle (AOTV)

p 3 N87-20682 Orbital transfer vehicle concept definition and system analysis study. Volume 1A: Executive summary. Phase 2 [NASA-CR-179055] p 161 N87-21018

Thermodynamic analysis and subscale modeling of space-based orbit transfer vehicle cryogenic propellant [NASA-TM-89921] p 96 N87-22949

System technology analysis of aeroassisted orbital transfer vehicles. Moderate lift/drag (0.75-1.5). Volume 1A, part 1: Executive summary, phase 1

[NASA-CR-179139]

System technology analysis of aeroassisted orbital transfer vehicles. Moderate lift/drag (0.75-1.5): Volume 1A, part 2: Executive summary, phase 2

[NASA-CR-179140] System technology analysis of aeroassisted orbital transfer vehicles: Moderate lift/drag (0.75-1.5). Volume 3: Cost estimates and work breakdown structure/dictionary, phase 1 and 2

[NASA-CR-179144] p 3 N87-26064 System technology analysis of aeroassisted orbital transfer vehicles: Moderate lift/drag (0.75-1.5), volume 1B, part 1, study results

[NASA-CR-179141] System technology analysis of aeroassisted orbital transfer vehicles: Moderate lift/drag (0.75-1.5), Volume 1B, part 2, study results

[NASA-CR-1791421 p 4 N87-26067 Design and demonstrate the performance of cryogenic components representative of space vehicles: Start basket liquid acquisition device performance analysis

[NASA-CR-179138] p 97 N87-26081 Concepts for space maintenance of OTV engines

p 137 N87-26097 Evaluation of carbon-carbon for space engine nozzle p 98 N87-26116

#### **ORBITAL ASSEMBLY**

Space Station EVA simulation demonstrates orbital p 132 A87-32006 Transient dynamics of orbiting flexible structural p 54 A87-32338

The Mast Flight System dynamic characteristics and actuator/sensor selection and location

[AAS PAPER 86-003] p 13 A87-32729 Alternative methods to fold/deploy tetrahedral or pentahedral truss platforms p 19 A87-34467 p 135 A87-40376 On-orbit assembly and repair

Design, construction, and utilization of a space station assembled from 5-meter erectable struts

p 34 N87-24501 Preliminary analysis of a prototype space solar power

evetem [ILR-MITT-168] p 79 N87-24532

Bi-stem gripping apparatus [NASA-CASE-MFS-28185-1]

p 107 N87-25586 Experimental evaluation of small-scale erectable truss [NASA-TM-89068]

p 37 N87-26085

# **ORBITAL ELEMENTS**

Synergetic plane-change capability of a conceptual

aeromaneuvering-orbital-transfer vehicle
[AIAA PAPER 87-2565] p 92 A87-49615 ORBITAL MANEUVERING VEHICLES

Use of the Orbital Maneuvering Vehicle (OMV) for placement and retrieval of spacecraft and platforms [AAS PAPER 86-041] p 133 A87-32743

A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677

Mobile remote manipulator vehicle system p 103 N87-29118 [NASA-CASE-LAR-13393-1] ORBITAL MANEUVERS

Computer simulation of on-orbit manned maneuvering unit operations

[SAE PAPER 861783] Shuttle orbit flight control design lessons - Direction for Space Station p 58 A87-37295

Conceptual design and integration of a Space Station resistojet propulsion assembly [AIAA PAPER 87-1860] p 91 A87-45256

Synergetic plane-change capability of a conceptual aeromaneuvering-orbital-transfer vehicle [AIAA PAPER 87-2565] p 92 A87-49615

Optimal heading change with minimum energy loss for a hypersonic gliding vehicle

[AIAA PAPER 87-2568] p 136 A87-49618 Aeroassisted orbital maneuvering using Lyapunov optimal feedback control

[AIAA PAPER 87-2464] p 93 A87-50509 Conceptual design and integration of a space station resistojet propulsion assembly

[NASA-TM-89847] p 93 N87-20378 Maneuvering and vibration control of flexible pacecraft p 67 N87-22734 spacecraft

Slew maneuvers on the SCOLE Laboratory Facility p 69 N87-24511

Research in slewing and tracking control p 70 N87-24512 Singular perturbation analysis of AOTV related trajectory optimization problems

[NASA-CR-180301] p 137 N87-26927 Optimal nodal transfer and aeroassisted transfer by aerocruise p 138 N87-28577

It 6 Ab - O-bital Management Vabiate (OMA) for	Human factors in space station architecture 2. EVA access facility: A comparative analysis of 4 concepts for	The Vanderbilt University neutral O-beam facility
Use of the Orbital Maneuvering Vehicle (OMV) for placement and retrieval of spacecraft and platforms	on-orbit space suit servicing	p 105 A87-32059
[AAS PAPER 86-041] p 133 A87-32743	[NASA-TM-86856] p 52 N87-24064	Hyperbaric oxygen therapy for decompression accidents
Critical length for stable elongated orbiting structures	End effector development study. Volume 2: Service End	- Potential applications to Space Station Operation
p 148 A87-32819	Effector subsystem specification (SEESSPEC)	[SAE PAPER 860927] p 163 A87-38717
The orbit configuration panel report Columbus polar	in-orbiting servicing	Hydrogen-oxygen thruster with no products of
platforms p 157 N87-20640	[FOK-TR-R-86-091-VOL-2] p 102 N87-24486	combustion in exhaust plume
Solar array flight dynamic experiment	End effector development study, volume 1 in-orbit	[AIAA PAPER 87-1775] p 91 A87-45196 Hydrogen/oxygen economy for the space station
p 78 N87-22722	servicing	p 98 N87-26130
Adaptive momentum management for large space	[FOK-TR-R-86-091-VOL-1] p 102 N87-25336	Oxygen interaction with space-power materials
structures [NASA-CR-179085] p 67 N87-22758	End effector development study. Volume 3: Appendices	[NASA-CR-181396] p 132 N87-29633
[NASA-CR-179085] p 67 N87-22758 An analysis of space station motion subject to the	in-orbit servicing [FOK-TR-R-86-091-VOL-3] p 102 N87-25337	OXYGEN ATOMS
parametric excitation of periodic elevator motion	Quick-disconnect inflatable seal assembly	High intensity 5 eV CW laser sustained 0-atom exposure
[AD-A179235] p 68 N87-23681	[NASA-CASE-KSC-11368-1] p 102 N87-25583	facility for material degradation studies
Proceedings of the Second International Symposium on	An analysis of bipropellant neutralization for spacecraft	p 105 A87-32060
Spacecraft Flight Dynamics	refueling operations p 97 N87-25888	Selected materials issues associated with Space
[ESA-SP-255] p 171 N87-25354	A study of fluid transfer management in space	Station p 105 A87-32061
ORBITAL RENDEZVOUS	[FTMS-RPT-006] p 97 N87-26058	Martin Marietta atomic oxygen beam facility
Attitude and Orientation System (AOCS) tasks on	Service Manipulator Arm (SMA) for a Robotic Servicing	p 139 A87-38622 A high flux pulsed source of energetic atomic oxygen
Rendezvous and Docking (RVD) (docking-undocking	Experiment (ROSE)	for spacecraft materials ground testing
phases). Architecture of the whole simulator, volume 2 [LP-RP-Al-204-VOL-2] p 68 N87-24490	[ESA-CR(P)-2347] p 103 N87-28260	p 139 A87-38623
[LP-RP-Al-204-VOL-2] p 68 N87-24490 Attitude and Orientation Control System (AOCS) tasks	Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 103 N87-29118	Production of a beam of ground state oxygen atoms
on Rendezvous and Docking (RVD) (docking-undocking	Development of a standard connector for orbital	of selectable energy p 139 A87-38624
phases). Simulation set-up and results, volume 3	replacement units for serviceable spacecraft	Production of pulsed atomic oxygen beams via laser
[LP-RP-Al-204-VOL-3] p 69 N87-24491	p 40 N87-29864	vaporization methods p 106 A87-38625
Attitude and Orientation Control System (AOCS) tasks	Telerobotic work system: Concept development and	Structure-property relationships in polymer resistance
on Rendezvous and Docking (RVD) (docking-undocking	evolution p 104 N87-29866	to atomic oxygen p 106 A87-38642
phases). Docking-undocking phase analysis	ORBITAL SPACE STATIONS	Variable energy, high flux, ground-state atomic oxygen
[LP-RP-AI-204-VOL-1] p 70 N87-24514	Developing a voice-controlled, computer-generated	source [NASA-CASE-NPO-16640-1-CU] p 8 N87-21661
ORBITAL SERVICING	display to assist space station astronauts during	[NASA-CASE-NPO-16640-1-CU] p 8 N87-21661 Proceedings of the NASA Workshop on Atomic Oxygen
Space Station integration and verification concepts	maintenance activity	Effects low earth orbital environment
p 84 A87-31461 An enclosed hangar concept for large spacecraft	[AD-A178997] p 120 N87-22762 Military man in space: A history of Air Force efforts to	[NASA-CR-181163] p 141 N87-26173
servicing at Space Station p 146 A87-32534	find a manned space mission	Review of Low Earth Orbital (LEO) flight experiments
On-orbit fluid management p 132 A87-32543	[AD-A179873] p 171 N87-25815	p 131 N87-26174
Satellite servicing logistics	ORBITAL SPACE TESTS	Material interactions with the Low Earth Orbital (LEO)
[SAE PAPER 861723] p 132 A87-32612	Evaluation testing of a mechanical actuator component	environment: Accurate reaction rate measurements
Hubble Space Telescope satellite servicing	operating in a simulated space environment	p 108 N87-26175
[SAE PAPER 861796] p 133 A87-32644	p 160 A87-32549	Mass spectrometers and atomic oxygen
Refueling satellites in space - The OSCRS program	Space station: A program overview	p 141 N87-26176 Interaction of hyperthermal atoms on surfaces in orbit:
[SAE PAPER 861797] p 88 A87-32645	p 171 N87-24496	The University of Alabama experiment
Use of the Orbital Maneuvering Vehicle (OMV) for	The evolution of a serviceable EURECA [MBB-UR-E-923/86] p 121 N87-26841	p 108 N87-26177
placement and retrieval of spacecraft and platforms [AAS PAPER 86-041] p 133 A87-32743	[MBB-UR-E-923/86] p 121 N87-26841 ORGANIC COMPOUNDS	O-atom degradation mechanisms of materials
Planning for unanticipated satellite servicing	Kinetics and mechanisms of some atomic oxygen	p 141 N87-26178
teleoperations p 118 A87-33048	reactions p 141 N87-26179	Kinetics and mechanisms of some atomic oxygen
Transferring superfluid helium in space	ORGANIC MATERIALS	reactions p 141 N87-26179
p 88 A87-34712	Potential energy surfaces for atomic oxygen reactions:	Product energy distributions and energy partitioning in
The SERVICE concept p 134 A87-36362	Formation of singlet and triplet biradicals as primary	O atom reactions on surfaces p 108 N87-26180
Demands imposed on a surface tension propellant tank	reaction products with unsaturated organic molecules	The role of electronic mechanisms in surface erosion
due to refuellability in the microgravity environment of outer	p 108 N87-26182	and glow phenomena p 137 N87-26181 Potential energy surfaces for atomic oxygen reactions:
space [DGLR PAPER 86-104] p 88 A87-36756	OSCILLATION DAMPERS	Formation of singlet and triplet biradicals as primary
[DGLR PAPER 86-104] p 88 A87-36756 A maintenance work station for Space Station	Response bounds for linear underdamped systems [ASME PAPER 87-APM-34] p 59 A87-42505	reaction products with unsaturated organic molecules
		p 108 N87-26182
ISAE PAPER 8609331 D 107 A07-30723	DIS (ESA)	Dominion of story systems interestings
[SAE PAPER 860933] p 167 A87-38723 The development of an EVA Universal Work Station	OTS (ESA)  Enhancement of solar absorptance degradation due to	Dynamics of atom-surface interactions
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739		p 141 N87-26183
The development of an EVA Universal Work Station	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p 4 N87-26185
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346 OXIDATION	p 141 N87-26183  Laboratory studies of atomic oxygen reactions with solids  p 4 N87-26185  High intensity 5 eV atomic oxygen source and Low Earth
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p 4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p 141 N87-26186
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p 4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p 141 N87-26186 Neutral atomic oxygen beam produced by ion charge
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622 A high flux pulsed source of energetic atomic oxygen	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p 4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p 141 N87-26186 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376 An integrated approach to spacecraft design for robotic	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622  A high flux pulsed source of energetic atomic oxygen for spacecraft materials ground testing	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p 4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p 141 N87-26186 Neutral atomic oxygen beam produced by ion charge
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376 An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672] p 100 A87-41152	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622 A high flux pulsed source of energetic atomic oxygen	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p 141 N87-26186 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p 131 N87-26188 Pulsed source of energetic atomic oxygen p 108 N87-26189
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376 An integrated approach to spacecraft design for robotic servicing	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622  A high flux pulsed source of energetic atomic oxygen for spacecraft materials ground testing p 139 A87-38623	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p 141 N87-26186 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p 131 N87-26188 Pulsed source of energetic atomic oxygen p 108 N87-26189 Production of pulsed atomic oxygen beams via laser
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376 An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672] p 100 A87-41152 The Canadian Robotic System for the Space Station [AIAA PAPER 87-1677] p 100 A87-41153	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622  A high flux pulsed source of energetic atomic oxygen of or spacecraft materials ground testing p 139 A87-38623  Supercritical water oxidation - Concept analysis for	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p 4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p 141 N87-26186 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p 131 N87-26188 Pulsed source of energetic atomic oxygen p 108 N87-26189 Production of pulsed atomic oxygen beams via laser vaporization methods p 109 N87-26190
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376 An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672] p 100 A87-41152 The Canadian Robotic System for the Space Station [AIAA PAPER 87-1677] m Modeling of fluid transfer in orbit	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622  A high flux pulsed source of energetic atomic oxygen for spacecraft materials ground testing p 139 A87-38623  Supercritical water oxidation - Concept analysis for evolutionary Space Station application [SAE PAPER 860993] p 51 A87-38770 Oxidation protection coatings for polymers	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p 141 N87-26186 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p 131 N87-26188 Pulsed source of energetic atomic oxygen p 108 N87-26189 Production of pulsed atomic oxygen beams via laser vaporization methods p 109 N87-26190 The production of low-energy neutral oxygen beams by
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376 An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672] p 100 A87-41152 The Canadian Robotic System for the Space Station [AIAA PAPER 87-1677] p 100 A87-41153 Modeling of fluid transfer in orbit [AIAA PAPER 87-1763] p 90 A87-45190	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622  A high flux pulsed source of energetic atomic oxygen	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p 141 N87-26186 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p 131 N87-26188 Pulsed source of energetic atomic oxygen p 108 N87-26189 Production of pulsed atomic oxygen beams via laser vaporization methods p 109 N87-26190 The production of low-energy neutral oxygen beams by grazing-incidence neutralization p 131 N87-26191
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376 An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672] p 100 A87-41152 The Canadian Robotic System for the Space Station [AIAA PAPER 87-1677] p 100 A87-41153 Modeling of fluid transfer in orbit [AIAA PAPER 87-1763] p 90 A87-45190 Operation of the orbital spacecraft consumables	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622  A high flux pulsed source of energetic atomic oxygen	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p 4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p 141 N87-26186 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p 131 N87-26188 Pulsed source of energetic atomic oxygen p 108 N87-26189 Production of pulsed atomic oxygen beams via laser vaporization methods p 109 N87-26190 The production of low-energy neutral oxygen beams by grazing-incidence neutralization p 131 N87-26191 An electrically conductive thermal control surface for
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376 An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672] p 100 A87-41152 The Canadian Robotic System for the Space Station [AIAA PAPER 87-1677] p 100 A87-41153 Modeling of fluid transfer in orbit [AIAA PAPER 87-1763] p 90 A87-45190 Operation of the orbital spacecraft consumables resupply system (OSCRS) at the Space Station	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622  A high flux pulsed source of energetic atomic oxygen	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p 141 N87-26186 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p 131 N87-26188 Pulsed source of energetic atomic oxygen p 108 N87-26189 Production of pulsed atomic oxygen beams via laser vaporization methods p 109 N87-26190 The production of low-energy neutral oxygen beams by grazing-incidence neutralization p 131 N87-26191 An electrically conductive thermal control surface for spacecraft encountering Low-Earth Orbit (LEO) atomic
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376 An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672] p 100 A87-41152 The Canadian Robotic System for the Space Station [AIAA PAPER 87-1673] p 100 A87-41153 Modeling of fluid transfer in orbit [AIAA PAPER 87-1763] p 90 A87-45190 Operation of the orbital spacecraft consumables resupply system (OSCRS) at the Space Station [AIAA PAPER 87-1768] p 135 A87-45192	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622  A high flux pulsed source of energetic atomic oxygen or or spacecraft materials ground testing p 139 A87-38623  Supercritical water oxidation - Concept analysis for evolutionary Space Station application  [SAE PAPER 860993] p 51 A87-38770  Oxidation protection coatings for polymers  [NASA-CASE-LEW-14072-3] p 107 N87-23736  Kinetics and mechanisms of some atomic oxygen reactions p 141 N87-26179  Product energy distributions and energy partitioning in	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p141 N87-26186 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p131 N87-26188 Pulsed source of energetic atomic oxygen p108 N87-26189 Production of pulsed atomic oxygen beams via laser vaporization methods p109 N87-26190 The production of low-energy neutral oxygen beams by grazing-incidence neutralization p131 N87-26191 An electrically conductive thermal control surface for spacecraft encountering Low-Earth Orbit (LEO) atomic oxygen indium tin oxide-coated thermal blankets
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376 An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672] p 100 A87-41152 The Canadian Robotic System for the Space Station [AIAA PAPER 87-1763] p 100 A87-41153 Modeling of fluid transfer in orbit [AIAA PAPER 87-1763] p 90 A87-45190 Operation of the orbital spacecraft consumables resupply system (OSCRS) at the Space Station [AIAA PAPER 87-1768] p 135 A87-45192 Ariane transfer vehicle (ATV) to supply Space Station	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622 A high flux pulsed source of energetic atomic oxygen or or spacecraft materials ground testing p 139 A87-38623 Supercritical water oxidation - Concept analysis for evolutionary Space Station application [SAE PAPER 860993] p 51 A87-38770 Oxidation protection coatings for polymers [NASA-CASE-LEW-14072-3] p 107 N87-23736 Kinetics and mechanisms of some atomic oxygen reactions p 141 N87-26179 Product energy distributions and energy partitioning in O atom reactions on surfaces p 108 N87-26180	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p 141 N87-26186 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p 131 N87-26188 Pulsed source of energetic atomic oxygen p 108 N87-26189 Production of pulsed atomic oxygen beams via laser vaporization methods p 109 N87-26190 The production of low-energy neutral oxygen beams by grazing-incidence neutralization p 131 N87-26191 An electrically conductive thermal control surface for spacecraft encountering Low-Earth Orbit (LEO) atomic
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376 An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672] p 100 A87-41152 The Canadian Robotic System for the Space Station [AIAA PAPER 87-1763] p 100 A87-41153 Modeling of fluid transfer in orbit [AIAA PAPER 87-1763] p 90 A87-45190 Operation of the orbital spacecraft consumables resupply system (OSCRS) at the Space Station [AIAA PAPER 87-1768] p 135 A87-45192 Ariane transfer vehicle (ATV) to supply Space Station [AIAA PAPER 87-1862] p 152 A87-45257	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622  A high flux pulsed source of energetic atomic oxygen or or spacecraft materials ground testing p 139 A87-38623  Supercritical water oxidation - Concept analysis for evolutionary Space Station application  [SAE PAPER 860993] p 51 A87-38770  Oxidation protection coatings for polymers  [NASA-CASE-LEW-14072-3] p 107 N87-23736  Kinetics and mechanisms of some atomic oxygen reactions p 141 N87-26179  Product energy distributions and energy partitioning in	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p 141 N87-26186 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p 131 N87-26188 Pulsed source of energetic atomic oxygen p 108 N87-26189 Production of pulsed atomic oxygen beams via laser vaporization methods p 109 N87-26190 The production of low-energy neutral oxygen beams by grazing-incidence neutralization p 131 N87-26191 An electrically conductive thermal control surface for spacecraft encountering Low-Earth Orbit (LEO) atomic oxygen indium tin oxide-coated thermal blankets p 45 N87-26192 Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376 An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672] p 100 A87-41152 The Canadian Robotic System for the Space Station [AIAA PAPER 87-1763] p 100 A87-41153 Modeling of fluid transfer in orbit [AIAA PAPER 87-1763] p 90 A87-45190 Operation of the orbital spacecraft consumables resupply system (OSCRS) at the Space Station [AIAA PAPER 87-1768] p 135 A87-45192 Ariane transfer vehicle (ATV) to supply Space Station [AIAA PAPER 87-1862] p 152 A87-45257 Mixing-induced ullage condensation and fluid destratification	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622  A high flux pulsed source of energetic atomic oxygen	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p 141 N87-26186 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p 131 N87-26188 Pulsed source of energetic atomic oxygen p 108 N87-26189 Production of pulsed atomic oxygen beams via laser vaporization methods p 109 N87-26190 The production of low-energy neutral oxygen beams by grazing-incidence neutralization p 131 N87-26191 An electrically conductive thermal control surface for spacecraft encountering Low-Earth Orbit (LEO) atomic oxygen indium tin oxide-coated thermal blankets p 45 N87-26192 Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197 Groundbased studies of spacecraft glow and erosion
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376 An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672] p 100 A87-41152 The Canadian Robotic System for the Space Station [AIAA PAPER 87-1677] p 100 A87-41153 Modeling of fluid transfer in orbit [AIAA PAPER 87-1763] p 90 A87-45190 Operation of the orbital spacecraft consumables resupply system (OSCRS) at the Space Station [AIAA PAPER 87-1768] p 135 A87-45192 Ariane transfer vehicle (ATV) to supply Space Station [AIAA PAPER 87-1862] p 152 A87-45257 Mixing-induced ullage condensation and fluid destratification [AIAA PAPER 87-2018] p 92 A87-45357	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622  A high flux pulsed source of energetic atomic oxygen	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p 141 N87-26186 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p 131 N87-26188 Pulsed source of energetic atomic oxygen p 108 N87-26189 Production of pulsed atomic oxygen beams via laser vaporization methods p 109 N87-26190 The production of low-energy neutral oxygen beams by grazing-incidence neutralization p 131 N87-26191 An electrically conductive thermal control surface for spacecraft encountering Low-Earth Orbit (LEO) atomic oxygen indium tin oxide-coated thermal blankets p 45 N87-26192 Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197 Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376 An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672] p 100 A87-41152 The Canadian Robotic System for the Space Station [AIAA PAPER 87-1677] p 100 A87-41153 Modeling of fluid transfer in orbit [AIAA PAPER 87-1763] p 90 A87-45190 Operation of the orbital spacecraft consumables resupply system (OSCRS) at the Space Station [AIAA PAPER 87-1768] p 135 A87-45192 Ariane transfer vehicle (ATV) to supply Space Station [AIAA PAPER 87-1862] p 152 A87-45257 Mixing-induced ullage condensation and fluid destratification [AIAA PAPER 87-2018] p 92 A87-45357 Concepts for space maintenance of OTV engines	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622  A high flux pulsed source of energetic atomic oxygen	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p 141 N87-26186 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p 131 N87-26188 Pulsed source of energetic atomic oxygen p 108 N87-26189 Production of pulsed atomic oxygen beams via laser vaporization methods p 109 N87-26190 The production of low-energy neutral oxygen beams by grazing-incidence neutralization p 131 N87-26191 An electrically conductive thermal control surface for spacecraft encountering Low-Earth Orbit (LEO) atomic oxygen indium tin oxide-coated thermal blankets  p 45 N87-26192 Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197 Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376 An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672] p 100 A87-41152 The Canadian Robotic System for the Space Station [AIAA PAPER 87-1677] modeling of fluid transfer in orbit [AIAA PAPER 87-1763] p 90 A87-45190 Operation of the orbital spacecraft consumables resupply system (OSCRS) at the Space Station [AIAA PAPER 87-1768] p 135 A87-45192 Ariane transfer vehicle (ATV) to supply Space Station [AIAA PAPER 87-1862] p 152 A87-45192 Mixing-induced ullage condensation and fluid destratification [AIAA PAPER 87-2018] p 92 A87-45357 Concepts for space maintenance of OTV engines p 136 A87-46000	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622  A high flux pulsed source of energetic atomic oxygen	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p141 N87-26186 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p131 N87-26188 Pulsed source of energetic atomic oxygen p108 N87-26189 Production of pulsed atomic oxygen beams via laser vaporization methods p109 N87-26190 The production of low-energy neutral oxygen beams by grazing-incidence neutralization p131 N87-26191 An electrically conductive thermal control surface for spacecraft encountering Low-Earth Orbit (LEO) atomic oxygen indium tin oxide-coated thermal blankets p45 N87-26192 Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p109 N87-26197 Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams p109 N87-26200 Potential surfaces for O atom-polymer reactions
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376 An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672] p 100 A87-41152 The Canadian Robotic System for the Space Station [AIAA PAPER 87-1677] p 100 A87-41153 Modeling of fluid transfer in orbit [AIAA PAPER 87-1763] p 90 A87-45190 Operation of the orbital spacecraft consumables resupply system (OSCRS) at the Space Station [AIAA PAPER 87-1763] p 135 A87-45192 Ariane transfer vehicle (ATV) to supply Space Station [AIAA PAPER 87-1862] p 152 A87-45257 Mixing-induced ullage condensation and fluid destratification [AIAA PAPER 87-2018] p 92 A87-45357 Concepts for space maintenance of OTV engines p 136 A87-46000 The mission function control for deployment and retrieval	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622  A high flux pulsed source of energetic atomic oxygen	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p141 N87-26186 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p131 N87-26188 Pulsed source of energetic atomic oxygen beams via laser p108 N87-26189 Production of pulsed atomic oxygen beams via laser vaporization methods p109 N87-26190 The production of low-energy neutral oxygen beams by grazing-incidence neutralization p131 N87-26191 An electrically conductive thermal control surface for spacecraft encountering Low-Earth Orbit (LEO) atomic oxygen indium tin oxide-coated thermal blankets p45 N87-26192 Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p109 N87-26190 Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams p109 N87-26200 Potential surfaces for O atom-polymer reactions p109 N87-26201
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376 An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672] p 100 A87-41152 The Canadian Robotic System for the Space Station [AIAA PAPER 87-1677] p 100 A87-41153 Modeling of fluid transfer in orbit [AIAA PAPER 87-1763] p 90 A87-45190 Operation of the orbital spacecraft consumables resupply system (OSCRS) at the Space Station [AIAA PAPER 87-1768] p 135 A87-45192 Ariane transfer vehicle (ATV) to supply Space Station [AIAA PAPER 87-1862] p 152 A87-45257 Mixing-induced ullage condensation and fluid destratification [AIAA PAPER 87-2018] p 92 A87-45357 Concepts for space maintenance of OTV engines p 136 A87-46000 The mission function control for deployment and retrieval of subsatellite	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622  A high flux pulsed source of energetic atomic oxygen	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p141 N87-26186 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p131 N87-26188 Pulsed source of energetic atomic oxygen p108 N87-26189 Production of pulsed atomic oxygen beams via laser vaporization methods p109 N87-26190 The production of low-energy neutral oxygen beams by grazing-incidence neutralization p131 N87-26191 An electrically conductive thermal control surface for spacecraft encountering Low-Earth Orbit (LEO) atomic oxygen indium tin oxide-coated thermal blankets p45 N87-26192 Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p109 N87-26197 Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams p109 N87-26200 Potential surfaces for O atom-polymer reactions
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376 An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672] p 100 A87-41152 The Canadian Robotic System for the Space Station [AIAA PAPER 87-1677] p 100 A87-41153 Modeling of fluid transfer in orbit [AIAA PAPER 87-1763] p 90 A87-45190 Operation of the orbital spacecraft consumables resupply system (OSCRS) at the Space Station [AIAA PAPER 87-1768] p 135 A87-45192 Ariane transfer vehicle (ATV) to supply Space Station [AIAA PAPER 87-1862] p 152 A87-45257 Mixing-induced ullage condensation and fluid destratification [AIAA PAPER 87-2018] p 92 A87-4597 Concepts for space maintenance of OTV engines p 136 A87-46000 The mission function control for deployment and retrieval of subsatellite	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622  A high flux pulsed source of energetic atomic oxygen	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p 141 N87-26186 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p 131 N87-26188 Pulsed source of energetic atomic oxygen p 108 N87-26189 Production of pulsed atomic oxygen beams via laser vaporization methods p 109 N87-26190 The production of low-energy neutral oxygen beams by grazing-incidence neutralization p 131 N87-26191 An electrically conductive thermal control surface for spacecraft encountering Low-Earth Orbit (LEO) atomic oxygen indium tin oxide-coated thermal blankets p 45 N87-26192 Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197 Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams p 109 N87-26200 Potential surfaces for O atom-polymer reactions p 109 N87-26201 NASA Marshall Space Flight Center atomic oxygen
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376 An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672] p 100 A87-41152 The Canadian Robotic System for the Space Station [AIAA PAPER 87-1677] p 100 A87-41153 Modeling of fluid transfer in orbit [AIAA PAPER 87-1763] p 90 A87-45190 Operation of the orbital spacecraft consumables resupply system (OSCRS) at the Space Station [AIAA PAPER 87-1768] p 135 A87-45192 Ariane transfer vehicle (ATV) to supply Space Station [AIAA PAPER 87-1862] p 152 A87-45257 Mixing-induced ullage condensation and fluid destratification [AIAA PAPER 87-2018] p 92 A87-45357 Concepts for space maintenance of OTV engines p 136 A87-46000 The mission function control for deployment and retrieval of subsatellite	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622  A high flux pulsed source of energetic atomic oxygen	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p 141 N87-26186 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p 131 N87-26188 Pulsed source of energetic atomic oxygen p 108 N87-26189 Production of pulsed atomic oxygen beams via laser vaporization methods p 109 N87-26190 The production of low-energy neutral oxygen beams by grazing-incidence neutralization p 131 N87-26191 An electrically conductive thermal control surface for spacecraft encountering Low-Earth Orbit (LEO) atomic oxygen indium tin oxide-coated thermal blankets p 45 N87-26192 Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197 Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams p 109 N87-26200 Potential surfaces for O atom-polymer reactions p 109 N87-26201 NASA Marshall Space Flight Center atomic oxygen investigations p 109 N87-26202 An evaluation of candidate oxidation resistant naterials p 110 N87-26203
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376 An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672] p 100 A87-41152 The Canadian Robotic System for the Space Station [AIAA PAPER 87-1677] p 100 A87-41153 Modeling of fluid transfer in orbit [AIAA PAPER 87-1763] p 90 A87-45190 Operation of the orbital spacecraft consumables resupply system (OSCRS) at the Space Station [AIAA PAPER 87-1768] p 135 A87-45192 Ariane transfer vehicle (ATV) to supply Space Station [AIAA PAPER 87-1862] p 152 A87-45257 Mixing-induced ullage condensation and fluid destratification [AIAA PAPER 87-2018] p 92 A87-45357 Concepts for space maintenance of OTV engines p 136 A87-46000 The mission function control for deployment and retrieval of subsatellitie [AIAA PAPER 87-2326] p 126 A87-50447 Progress on the Ohio State University Get Away Special	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility     p 139 A87-38622  A high flux pulsed source of energetic atomic oxygen	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p 141 N87-26186 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p 131 N87-26188 Pulsed source of energetic atomic oxygen beams via laser vaporization methods p 108 N87-26189 Production of pulsed atomic oxygen beams via laser vaporization methods p 109 N87-26190 The production of low-energy neutral oxygen beams by grazing-incidence neutralization p 131 N87-26191 An electrically conductive thermal control surface for spacecraft encountering Low-Earth Orbit (LEO) atomic oxygen indium tin oxide-coated thermal blankets p 45 N87-26192 Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197 Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams p 109 N87-26200 Potential surfaces for O atom-polymer reactions p 109 N87-26201 NASA Marshall Space Flight Center atomic oxygen investigations p 109 N87-26202 An evaluation of candidate oxidation resistant materials p 110 N87-26203 Martin Marietta atomic oxygen Low Earth Orbit (LEO)
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376 An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672] p 100 A87-41152 The Canadian Robotic System for the Space Station [AIAA PAPER 87-1677] p 100 A87-41153 Modeling of fluid transfer in orbit [AIAA PAPER 87-1763] p 90 A87-45190 Operation of the orbital spacecraft consumables resupply system (OSCRS) at the Space Station [AIAA PAPER 87-1768] p 135 A87-45192 Ariane transfer vehicle (ATV) to supply Space Station [AIAA PAPER 87-1862] p 152 A87-45257 Mixing-induced ullage condensation and fluid destratification [AIAA PAPER 87-2018] p 92 A87-45357 Concepts for space maintenance of OTV engines p 136 A87-46000 The mission function control for deployment and retrieval of subsatellite [AIAA PAPER 87-2326] p 126 A87-50447 Progress on the Ohio State University Get Away Special G-0318: DEAP p 170 N87-20311 Satellite servicing mission preliminary cost estimation model	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622 A high flux pulsed source of energetic atomic oxygen	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p141 N87-26186 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p131 N87-26188 Pulsed source of energetic atomic oxygen p108 N87-26189 Production of pulsed atomic oxygen beams via laser vaporization methods p109 N87-26190 The production of low-energy neutral oxygen beams by grazing-incidence neutralization p131 N87-26191 An electrically conductive thermal control surface for spacecraft encountering Low-Earth Orbit (LEO) atomic oxygen indium tin oxide-coated thermal blankets p45 N87-26192 Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p109 N87-26197 Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams p109 N87-26200 Potential surfaces for O atom-polymer reactions p109 N87-26201 NASA Marshall Space Flight Center atomic oxygen investigations p109 N87-26202 An evaluation of candidate oxidation resistant materials p110 N87-26203 Martin Marietta atomic oxygen Low Earth Orbit (LEO) simulation p142 N87-26204
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376 An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672] p 100 A87-41152 The Canadian Robotic System for the Space Station [AIAA PAPER 87-1677] p 100 A87-41153 Modeling of fluid transfer in orbit [AIAA PAPER 87-1763] p 90 A87-45190 Operation of the orbital spacecraft consumables resupply system (OSCRS) at the Space Station [AIAA PAPER 87-1768] p 135 A87-45192 Ariane transfer vehicle (ATV) to supply Space Station [AIAA PAPER 87-1862] p 152 A87-45257 Mixing-induced ullage condensation and fluid destratification [AIAA PAPER 87-2018] p 92 A87-45357 Concepts for space maintenance of OTV engines p 136 A87-46000 The mission function control for deployment and retrieval of subsatellite [AIAA PAPER 87-2326] p 126 A87-50447 Progress on the Ohio State University Get Away Special G-0318: DEAP p 170 N87-20311 Satellite servicing mission preliminary cost estimation model [NASA-CR-171978] p 186 N87-20335	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622  A high flux pulsed source of energetic atomic oxygen	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p141 N87-26186 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p131 N87-26188 Pulsed source of energetic atomic oxygen p108 N87-26189 Production of pulsed atomic oxygen beams via laser vaporization methods p109 N87-26190 The production of low-energy neutral oxygen beams by grazing-incidence neutralization p131 N87-26191 An electrically conductive thermal control surface for spacecraft encountering Low-Earth Orbit (LEO) atomic oxygen indium tin oxide-coated thermal blankets p45 N87-26192 Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p109 N87-26197 Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams p109 N87-26200 Potential surfaces for O atom-polymer reactions p109 N87-26201 NASA Marshall Space Flight Center atomic oxygen investigations p109 N87-26203 An evaluation of candidate oxidation resistant materials p110 N87-26203 Martin Marietta atomic oxygen Low Earth Orbit (LEO) simulation p142 N87-26204 Spacecraft ram glow and surface temperature
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376 An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672] p 100 A87-41152 The Canadian Robotic System for the Space Station [AIAA PAPER 87-1677] modeling of fluid transfer in orbit [AIAA PAPER 87-1768] p 100 A87-45190 Operation of the orbital spacecraft consumables resupply system (OSCRS) at the Space Station [AIAA PAPER 87-1768] p 135 A87-45192 Ariane transfer vehicle (ATV) to supply Space Station [AIAA PAPER 87-1882] p 152 A87-45257 Mixing-induced ullage condensation and fluid destratification [AIAA PAPER 87-2018] p 92 A87-45357 Concepts for space maintenance of OTV engines p 136 A87-46000 The mission function control for deployment and retrieval of subsatellite [AIAA PAPER 87-2326] p 126 A87-50447 Progress on the Ohio State University Get Away Special G-0318: DEAP p 170 N87-20311 Satellite servicing mission preliminary cost estimation model [NASA-CR-171978] p 136 N87-20335 Servicing of the polar platform Columbus space	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622  A high flux pulsed source of energetic atomic oxygen	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p 141 N87-26186 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p 131 N87-26188 Pulsed source of energetic atomic oxygen beams via laser vaporization methods p 109 N87-26189 Production of pulsed atomic oxygen beams via laser vaporization methods p 109 N87-26190 The production of low-energy neutral oxygen beams by grazing-incidence neutralization p 131 N87-26191 An electrically conductive thermal control surface for spacecraft encountering Low-Earth Orbit (LEO) atomic oxygen indium tin oxide-coated thermal blankets p 45 N87-26192 Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26207 Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams p 109 N87-26200 Potential surfaces for O atom-polymer reactions p 109 N87-26201 NASA Marshall Space Flight Center atomic oxygen investigations p 109 N87-26202 An evaluation of candidate oxidation resistant materials p 110 N87-26203 Martin Marietta atomic oxygen Low Earth Orbit (LEO) simulation p 142 N87-26204 Spacecraft ram glow and surface temperature p 10 N87-26205
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376 An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672] p 100 A87-41152 The Canadian Robotic System for the Space Station [AIAA PAPER 87-1677] p 100 A87-41153 Modeling of fluid transfer in orbit [AIAA PAPER 87-1763] p 90 A87-45190 Operation of the orbital spacecraft consumables resupply system (OSCRS) at the Space Station [AIAA PAPER 87-1768] p 135 A87-45192 Ariane transfer vehicle (ATV) to supply Space Station [AIAA PAPER 87-1862] p 152 A87-45257 Mixing-induced ullage condensation and fluid destratification [AIAA PAPER 87-2018] p 92 A87-45357 Concepts for space maintenance of OTV engines p 136 A87-46000 The mission function control for deployment and retrieval of subsatellite [AIAA PAPER 87-2326] p 126 A87-50447 Progress on the Ohio State University Get Away Special G-0318: DEAP p 170 N87-20311 Satellite servicing mission preliminary cost estimation model [NASA-CR-171978] p 136 N87-20335 Servicing of the polar platform Columbus space station p 136 N87-20628	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622 A high flux pulsed source of energetic atomic oxygen	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p141 N87-26186 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p131 N87-26188 Pulsed source of energetic atomic oxygen p108 N87-26189 Production of pulsed atomic oxygen p108 N87-26189 Production of pulsed atomic oxygen beams via laser vaporization methods p109 N87-26190 The production of low-energy neutral oxygen beams by grazing-incidence neutralization p131 N87-26191 An electrically conductive thermal control surface for spacecraft encountering Low-Earth Orbit (LEO) atomic oxygen indium tin oxide-coated thermal blankets p45 N87-26192 Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p109 N87-26197 Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams p109 N87-26200 Potential surfaces for O atom-polymer reactions p109 N87-26201 NASA Marshall Space Flight Center atomic oxygen investigations p109 N87-26202 An evaluation of candidate oxidation resistant materials p100 N87-26203 Martin Marietta atomic oxygen Low Earth Orbit (LEO) simulation p142 N87-26205 Comments on the interaction of materials with atomic
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376 An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672] p 100 A87-41152 The Canadian Robotic System for the Space Station [AIAA PAPER 87-1677] p 100 A87-41153 Modeling of fluid transfer in orbit [AIAA PAPER 87-1763] p 90 A87-45190 Operation of the orbital spacecraft consumables resupply system (OSCRS) at the Space Station [AIAA PAPER 87-1768] p 135 A87-45192 Ariane transfer vehicle (ATV) to supply Space Station [AIAA PAPER 87-1862] p 152 A87-45257 Mixing-induced ullage condensation and fluid destratification [AIAA PAPER 87-2018] p 92 A87-45357 Concepts for space maintenance of OTV engines p 136 A87-46000 The mission function control for deployment and retrieval of subsatellite [AIAA PAPER 87-2326] p 126 A87-50447 Progress on the Ohio State University Get Away Special G-0318: DEAP p 170 N87-20311 Satellite servicing mission preliminary cost estimation model [NASA-CR-171978] p 136 N87-20335 Servicing of the polar platform — Columbus space station p 136 N87-20628 Panel report on the polar platform servicing approach	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622  A high flux pulsed source of energetic atomic oxygen	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p 141 N87-26186 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p 131 N87-26188 Pulsed source of energetic atomic oxygen beams via laser production of pulsed atomic oxygen beams via laser vaporization methods p 109 N87-26199 The production of low-energy neutral oxygen beams by grazing-incidence neutralization p 131 N87-26191 An electrically conductive thermal control surface for spacecraft encountering Low-Earth Orbit (LEO) atomic oxygen indium tin oxide-coated thermal blankets p 45 N87-26192 Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197 Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams p 109 N87-26200 Potential surfaces for O atom-polymer reactions p 109 N87-26201 NASA Marshall Space Flight Center atomic oxygen investigations p 109 N87-26203 An evaluation of candidate oxidation resistant materials p 110 N87-26203 Martin Marietta atomic oxygen Low Earth Orbit (LEO) simulation p 142 N87-26205 Comments on the interaction of materials wit atomic oxygen p 110 N87-26205
The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739 Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755 Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 On-orbit assembly and repair p 135 A87-40376 An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672] p 100 A87-41152 The Canadian Robotic System for the Space Station [AIAA PAPER 87-1677] p 100 A87-41153 Modeling of fluid transfer in orbit [AIAA PAPER 87-1763] p 90 A87-45190 Operation of the orbital spacecraft consumables resupply system (OSCRS) at the Space Station [AIAA PAPER 87-1768] p 135 A87-45192 Ariane transfer vehicle (ATV) to supply Space Station [AIAA PAPER 87-1862] p 152 A87-45257 Mixing-induced ullage condensation and fluid destratification [AIAA PAPER 87-2018] p 92 A87-45357 Concepts for space maintenance of OTV engines p 136 A87-46000 The mission function control for deployment and retrieval of subsatellite [AIAA PAPER 87-2326] p 126 A87-50447 Progress on the Ohio State University Get Away Special G-0318: DEAP p 170 N87-20311 Satellite servicing mission preliminary cost estimation model [NASA-CR-171978] p 136 N87-20335 Servicing of the polar platform Columbus space station p 136 N87-20628	Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory measurements p 144 A87-32346  OXIDATION  Martin Marietta atomic oxygen beam facility p 139 A87-38622 A high flux pulsed source of energetic atomic oxygen	p 141 N87-26183 Laboratory studies of atomic oxygen reactions with solids p4 N87-26185 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p141 N87-26186 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p131 N87-26188 Pulsed source of energetic atomic oxygen p108 N87-26189 Production of pulsed atomic oxygen p108 N87-26189 Production of pulsed atomic oxygen beams via laser vaporization methods p109 N87-26190 The production of low-energy neutral oxygen beams by grazing-incidence neutralization p131 N87-26191 An electrically conductive thermal control surface for spacecraft encountering Low-Earth Orbit (LEO) atomic oxygen indium tin oxide-coated thermal blankets p45 N87-26192 Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p109 N87-26197 Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams p109 N87-26200 Potential surfaces for O atom-polymer reactions p109 N87-26201 NASA Marshall Space Flight Center atomic oxygen investigations p109 N87-26202 An evaluation of candidate oxidation resistant materials p100 N87-26203 Martin Marietta atomic oxygen Low Earth Orbit (LEO) simulation p142 N87-26205 Comments on the interaction of materials with atomic

OXYGE	N PR	വവ	CT	ON

Preliminary experimental study on the oxygen separating and concentrating system for CELSS p 46 A87-32455 Concept study of regenerable carbon dioxide removal and oxygen recovery system for the Space Station

p 46 A87-32544 Space Station life support oxygen generation by SPE

water electrolyzer systems [SAE PAPER 860949] p 49 A87-38736

OXYGEN RECOMBINATION

Spacecraft ram glow and surface temperature p 10 N87-26205

OXYGEN SUPPLY EQUIPMENT

Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363

## PACKETS (COMMUNICATION)

User data management p 4 N87-29163

PAINTS

evaluation of candidate oxidation resistant materials p 110 N87-26203

PANFIS

Slewing control experiment for a flexible panel

p 78 N87-22740 A new approach for vibration control in large space p 33 N87-22743 structures

**PARABOLIC ANTENNAS** 

Near-field testing of the 5-meter model of the tetrahedral truss antenna

[NASA-CR-178147]

p 30 N87-21987

PARALLEL COMPUTERS

A Lanczos eigenvalue method on a parallel computer - for large complex space structure free vibration analysis

[AIAA PAPER 87-0725]

p 13 A87-33565

computer

Experiences with the Lanczos method on a parallel p 21 A87-41159 PARALLEL PROCESSING (COMPUTERS)

Maximum likelihood identification using an array p 5 A87-32121 processor Substructure analysis using NICE/SPAR and

applications of force to linear and nonlinear structures -

INASA-CR-1803171

p 38 N87-27260 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2

[NASA-TM-892861 p 116 N87-29144

PARAMETER IDENTIFICATION

An identification method for flexible structures

[AIAA PAPER 87-0745] p 16 A87-33669 Design parameters and environmental considerations

for a reusable aeroassisted orbital transfer vehicle [AIAA PAPER 87-1505] p 160 A87-43031

Single-mode projection filters for identification and state estimation of flexible structures

[AIAA PAPER 87-23871 p 24 A87-50471 Adaptive identification of flexible structures by lattice filters

[AIAA PAPER 87-2458] p 24 A87-50504 On-line identification and attitude control for SCOLE [AIAA PAPER 87-2459] p. 61 A87-50505 p 61 A87-50505 Identification of large space structures - A factorization

approach p 25 A87-52966 Mass property estimation for control of asymmetrical p 63 A87-52968

A computer program for model verification of dynamic systems p 31 N87-22710 An overview of controls research on the NASA Langley

Research Center grid p 66 N87-22720 Moving-bank multiple model adaptive estimation applied to flexible spacestructure control

[AD-A178870] p 68 N87-22761 Application of physical parameter identification to element models p 34 N87-24505 Maximum likelihood parameter identification of flexible

spacecraft [ETN-87-902351 p 38 N87-27705 Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and

large flexible structures [AD-A183302] p 11 N87-29893 A spline-based parameter and state estimation technique for static models of elastic surfaces

INASA-CR-1804491 p 11 N87-30107

PARAMETERIZATION

Projection filters for modal parameter estimate for flexible structures [NASA-CR-1803031

p 38 N87-26583 PARTIAL DIFFERENTIAL EQUATIONS

Studies in nonlinear structural dynamics: Chaotic behavior and poynting effect p 26 N87-20348

**PATHS** 

Inadequacy of single-impulse transfers for path constrained rendezvous p 90 A87-41615

PAYLOAD ASSIST MODULE

Commercial US transfer vehicle overview

[SAE PAPER 861764] p 1 A87-32625 Japanese Experiment Module (JEM) preliminary design status p 151 A87-41570

PAYLOAD CONTROL

Payload boomerang technology for space experiments p 146 A87-32540 at very low gravity level Use of the Orbital Maneuvering Vehicle (OMV) for placement and retrieval of spacecraft and platforms [AAS PAPER 86-041] Process control and data acquisition for commercial

materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583 Linear quadratic control system design for Space Station

pointed payloads
[AIAA PAPER 87-25301 p 161 A87-50533

PAYLOAD DELIVERY (STS)

System technology analysis of aeroassisted orbital transfer vehicles. Moderate lift/drag (0.75-1.5). Volume 1A, part 1: Executive summary, phase 1

[NASA-CR-179139] System technology analysis of aeroassisted orbital transfer vehicles. Moderate lift/drag (0.75-1.5): Volume 1A, part 2: Executive summary, phase 2

[NASA-CR-1791401 p 3 N87-26063 System technology analysis of aeroassisted orbital transfer vehicles: Moderate lift/drag (0.75-1.5). Volume 3: Cost estimates and work breakdown structure/dictionary, phase 1 and 2

[NASA-CR-179144] p 3 N87-26064 System technology analysis of aeroassisted orbital transfer vehicles: Moderate lift/drag (0.75-1.5). Volume 2: Supporting research and technology report, phase 1 and

[NASA-CR-179143] p 3 N87-26065 System technology analysis of aeroassisted orbital transfer vehicles: Moderate lift/drag (0.75-1.5), Volume 1B,

part 2, study results [NASA-CR-179142] D 4 N87-26067 PAYLOAD DEPLOYMENT & RETRIEVAL SYSTEM

The mission function control for deployment and retrieval

of subsatellite [AIAA PAPER 87-2326] p 126 A87-50447

PAYLOAD INTEGRATION

Optimization of a program of experiments in connection with the operational planning of studies carried out with a spacecraft p 148 A87-34208 Science and payload options for animal and plant

research accommodations aboard the early Space Station

[SAE PAPER 860953] p 164 A87-38740

**PAYLOAD TRANSFER** 

The design and development of a mobile transporter system for the Space Station Remote Manipulator System p 104 N87-29865

**PAYLOADS** 

Space Station integration and verification concepts

Preliminary results of CHARGE-2 tethered payload experiment p 121 A87-32521
On the payload-tether technology providing the microgravity circumstances in the proximity of the Space Station p 122 A87-32533

Servicing of user payload equipment in the Space Station

[SAE PAPER 860973] p 134 A87-38755 From Eureca-A to Eureca-B p 155 A87-53916 Modal testing of the Olympus development model

stowed solar array p 27 N87-20366 An astrometric facility for planetary detection on the pace station

[NASA-TM-89436] p 128 N87-20841 Botanical payloads for platforms and space stations

[MBB-UR-E-921/86] p 158 N87-25340 Design of a mixed fleet transportation system to low Earth orbit. Volume 1: Executive summary. Volume 2: Near-term shuttle replacement. Volume 3: Heavy-lift cargo vehicle. Volume 4: Advanced technology shuttle p 5 N87-29583

### PENETRATION

Space station integrated wall design and penetration damage control

(NASA-CR-179165) p 39 N87-28581

Space station integrated wall design and penetration damage control. Task 3: Theoretical analysis of penetration mechanics

[NASA-CR-179166] p 39 N87-28582 Space station integrated wall design and penetration

damage control. Task 4: Impact detection/location [NASA-CR-179167] p 4 N87-28583 PERFORMANCE PREDICTION

Thermal deformation and electrical degradation of antenna reflector with truss backstructure

p 12 A87-32405

The Tethered Satellite System as a new remote sensing platform p 124 A87-39183 Control of an autonomous spacecraft rendezvous and

docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Aerospatiale solar arrays, in orbit performance

p 159 N87-28988

p 96 N87-23821

Computer simulation of deployment --- solar arrays p 10 N87-29002

Test results from the solar array flight experiment p 83 N87-29010

### PERFORMANCE TESTS

Evaluation of cryogenic system test options for the OTV on-orbit propellant depot

[AIAA PAPER 87-1498] p 90 A87-43027 Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger

[AIAA PAPER 87-1540] p 44 A87-44843 Preliminary performance characterizations of an engineering model multipropellant resistojet for space

station application [AIAA PAPER 87-21201 p 93 A87-50197 Near-field testing of the 5-meter model of the tetrahedral

truss antenna [NASA-CR-178147] p 30 N87-21987 A 2000-hour cyclic endurance test of a laboratory model

multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Experimental characterization of deployable trusses and

p 33 N87-22749 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application

[NASA-TM-100113]

PERMANENT MAGNETS Permanent-magnet linear alternators. I - Fundamental

equations. II - Design guidelines p 76 A87-39735 PERTURBATION

The effects of structural perturbations on decoupled control --- spacecraft p 35 N87-25359

PERTURBATION THEORY

Flexible system model reduction and control system design based upon actuator and sensor influence p 59 A87-46301 Perturbation analysis of internal balancing for lightly

damped mechanical systems with gyroscopic and circulatory forces p 22 A87-47812 Equations of motion for maneuvering flexible pacecraft p 63 A87-52965 spacecraft

Dynamic characteristics of a vibrating beam with periodic variation in bending stiffness p 32 N87-22726

Singular perturbation analysis of AOTV related trajectory optimization problems [NASA-CR-180301] p 137 N87-26927

PHASE CHANGE MATERIALS A transient analysis of phase change energy storage

ystem for solar dynamic power [AIAA PAPER 87-1469] p 77 A87-43004 The benefit of phase change thermal storage for

spacecraft thermal management AIAA PAPER 87-1482] p 43 A87-43014

PHASE SHIFT KEYING

Feasibility study on 8PSK, QPSK, TFM, by using CLASS for Space Station/TDRSS real measured channel

PHASE TRANSFORMATIONS

Phase change water recovery for Space Station -Parametric testing and analysis

[SAE PAPER 860986] PHASED ARRAYS

Optical arrays for future astronomical telescopes in p 126 A87-44533

Multiple beam phased array for Space Station Control Zone Communications

p 85 A87-45519 PHOTOELECTRIC EMISSION Potential modulations on SCATHA (Spacecraft Charging

At High Altitude) spacecraft

[AD-A1768151 p 140 N87-21024

PHOTOGRAMMETRY

Use of a video-photogrammetry system for the measurement of the dynamic response of the shuttle remote manipulator arm p 101 N87-20370

**PHOTOIONIZATION** Production of a beam of ground state oxygen atoms of selectable energy p 139 A87-38624

**PHOTOMASKS** Coded mask telescopes for X-ray astronomy

## **PHOTONS**

High energy gamma ray astronomy

p 129 N87-24258

p 123 A87-37785

p 113 A87-45485

p 51 A87-38765

	DI ACMA DENCITY	Soft mounted momentum compensated pointing system
PHOTOVOLTAIC CELLS	PLASMA DENSITY Theory of plasma contactors for electrodynamic tethered	for the Space Shuttle Orbiter p 59 A87-42817
Performance characteristics of a combination solar	satellite systems p 85 A87-41609	Control of multiple-mirror/flexible-structures in slew
photovoltaic heat engine energy converter [NASA-TM-89908] p 78 N87-23028	PLASMA DYNAMICS	maneuvers
[NASA-TM-89908] p 78 N87-23028 An overview of photovoltaic applications in space	A preliminary study of extended magnetic field structures	[AIAA PAPER 87-2324] p 24 A87-50445
p 80 N87-26414	in the ionosphere	On-line identification and attitude control for SCOLE
Design study of large area 8 cm x 8 cm wrapthrough	[NASA-CR-181004] p 140 N87-23066	[AIAA PAPER 87-2459] p 61 A87-50505
cells for space station p 80 N87-26424	PLASMA ENGINES	Linear quadratic control system design for Space Station
Advanced photovoltaic solar array design assessment	CP/MPS - Contained plasma magnetic propulsion	pointed payloads
p 80 N87-26429	system: An advanced propulsion concept	[AIAA PAPER 87-2530] p 161 A87-50533
Proceedings of the Fifth European Symposium on	[AIAA PAPER 87-1042] p 89 A87-38016	Large space structures ground experiment checkout
Photovoltaic Generators in Space	PLASMA EQUILIBRIUM	p 30 N87-22704
[ESA-SP-267] p 81 N87-28959	Computer modeling of high-voltage solar array	Structural/control interaction (payload pointing and
The space station power system p 81 N87-28960	experiment using the NASCAP/LEO (NASA Charging	micro-g) p 9 N87-22721
Status of space station power system	Analyzer Program/Low Earth Orbit) computer code	Precision pointing and control of flexible spacecraft p 66 N87-22723
p 84 N87-29915	[AD-A182589] p 81 N87-28186	Workshop on Structural Dynamics and Control
PHOTOVOLTAIC CONVERSION	PLASMA GENERATORS	Interaction of Flexible Structures p 32 N87-22728
Space station WP-04 power system. Volume 1:	Electrodynamic plasma motor/generator experiment	Impact of space station appendage vibrations on the
Executive summary	[AAS PAPER 86-210] p 89 A87-38569	pointing performance of gimballed payloads
[NASA-CR-179587-VOL-1] p 78 N87-23695	Plasma motor/generator reference system designs for	p 32 N87-22733
Space station WP-04 power system. Volume 2: Study	power and propulsion [AAS PAPER 86-229] p 89 A87-38572	Vibration isolation for line of sight performance
results (NASA-CR-179587-VOL-2) p 79 N87-23696	( · · · · · · · · · · · · · · · ·	improvement p 67 N87-22742
	PLASMA INTERACTIONS  Laboratory simulation of plasma interaction with high	Large spacecraft pointing and shape control
An overview of photovoltaic applications in space p 80 N87-26414		p 69 N87-24498
	voltage solar array p 145 A87-32388 Preliminary results of CHARGE-2 tethered payload	Control technology overview in CSI
Space station power system p 80 N87-26447  High power/large area PV systems	experiment p 121 A87-32521	p 69 N87-24507
p 80 N87-26452	Investigation of plasma contactors for use with orbiting	Slew maneuvers on the SCOLE Laboratory Facility
Alternative power generation concepts for space	wires	p 69 N87-24511
p 81 N87-28961	[NASA-CR-180922] p 129 N87-22509	SPOT/MEGS design and flight results obtained solar
AMOC: An alternative module configuration for	A preliminary study of extended magnetic field structures	array drive (MEGS) p 103 N87-29009
advanced solar arrays in low Earth orbits	in the ionosphere	POLAR ORBITS
p 159 N87-28968	[NASA-CR-181004] p 140 N87-23066	Design of a polar platform with an earth observation
PHYSIOLOGICAL EFFECTS	Electron beam experiments at high altitudes	payload p 122 A87-32538
Soviet space stations as analogs, second edition	p 142 N87-26946	A polar platform for the remote sensing needs of ecology
[NASA-CR-180920] p 157 N87-21996	Computer modeling of high-voltage solar array	and agriculture - A view from the U.K.
PHYSIOLOGICAL FACTORS	experiment using the NASCAP/LEO (NASA Charging	p 125 A87-41430
Physiological requirements and pressure control of a	Analyzer Program/Low Earth Orbit) computer code	The single-stage reusable ballistic launcher concept for economic cargo transportation p 135 A87-41573
spaceplane	[AD-A182589] p 81 N87-28186	economic cargo transportation p 135 A87-41573 Earth resources instrumentation for the Space Station
[SAE PAPER 860965] p 150 A87-38747	PLASMA JETS	Polar Platform p 126 A87-44184
Physiological aspects of EVA	Effects of space plasma discharge on the performance	Conceptual design of the High-Resolution Imaging
[SAE PAPER 860991] p 164 A87-38768	of large antenna structures in low Earth orbit [NASA-TM-89118] p 86 N87-20339	Spectrometer (HIRIS) for EOS p 126 A87-44185
PIEZOELECTRIC CERAMICS	[	The dynamics and control of the Space Station polar
Structural control by the use of piezoelectric active	PLASMA PROPULSION  CP/MPS - Contained plasma magnetic propulsion	platform
	system: An advanced propulsion concept	[AIAA PAPER 87-2600] p 62 A87-50562
An experimental investigation of vibration suppression in large space structures using positive position	[AIAA PAPER 87-1042] p 89 A87-38016	Proceedings of the European Symposium on Polar
feedback p 39 N87-28937	Development of the electrical power subsystem for the	platform Opportunities and Instrumentation for
PIEZOELECTRIC GAGES	electric propulsion experiment onboard the Space Flyer	Remote-Sensing (ESPOIR)
Effect of bonding on the performance of a	Unit (SFU)	[ESA-SP-266] p 128 N87-20621
piezoactuator-based active control system	[AIAA PAPER 87-1040] p 76 A87-39628	Working group on Earth observation requirements for
[NASA-CR-181414] p 74 N87-29713	Development of control and monitor subsystem for	the Polar Orbiting Platform Elements of the International
Optimum shape control of flexible beams by	electric propulsion experiment onboard Space Flyer Unit	Space Station (the POPE Working Group)
piezo-electric actuators	(SFU)	p 128 N87-20625
[NASA-CR-181413] p 40 N87-29898	[AIAA PAPER 87-1041] p 76 A87-39629	ESA Columbus polar platform design concept
PIEZOELECTRIC TRANSDUCERS	PLASMA SHEATHS	p 156 N87-20627
Optimal vibration control by the use of piezoceramic	Theory of plasma contactors for electrodynamic tethered	Servicing of the polar platform Columbus space station p 136 N87-20628
sensors and actuators	satellite systems p 85 A87-41609	station p 136 N87-20628 Orbit configurations space station polar platform
[AIAA PAPER 87-0959] p 18 A87-33751	The Aerospace Environment at High Altitudes and its	p 156 N87-20629
Structural control by the use of piezoelectric active	Implications for Spacecraft Charging and	Payload data management scheme planned for Earth
members p 69 N87-24509	Communications [AGARD-CP-406] p 142 N87-26937	observation sensors to be flown on the polar platforms
Vibration control of flexible structures using piezoelectric	C	in the framework of the space station/Columbus
devices as sensors and actuators p 37 N87-26387	PLASMAS (PHYSICS) Investigation of plasma contactors for use with orbiting	program p 114 N87-20630
Maximum likelihood identification using an array	wires	USA-Europe coordination and cooperation activities:
	[NASA-CR-180922] p 129 N87-22509	Announcements of Opportunity polar platforms
processor p 5 A87-32121 PLANAR STRUCTURES	Investigation of plasma contactors for use with orbiting	p 170 N87-20632
Substructure analysis using NICE/SPAR and	wires	Report of the atmosphere panel p 161 N87-20633
applications of force to linear and nonlinear structures	[NASA-CR-181422] p 131 N87-29591	Land panel report International Space Station
spacecraft masts	PLASTIC COATINGS	p 128 N87-20634
[NASA-CR-180317] p 38 N87-27260	Microcrack resistant structural composite tubes for	Ocean-ice panel report International Space Station
PLANETARY GEOLOGY	space applications p 106 A87-41022	p 156 N87-20635
Experimentation in planetary geology	PLASTICS	Solid Earth panel report Columbus program
p 124 A87-40319	Effects on advanced materials: Results of the STS-8	p 157 N87-20636 Panel report on multidisciplinary instrumentation: New
PLANETARY ORBITS	EOIM (Effects of Oxygen Interaction with Materials)	possibilities Columbus space station
A survey of tether applications to planetary exploration	experiment	p 161 N87-20637
[AAS PAPER 86-206] p 123 A87-38568	[AD-A182931] p 110 N87-29709	Panel report on new approaches to calibration and
PLANNING	PLUMES	validation Columbus polar platforms
Optimizing experimental programs in operational	External contamination environment of Space Station	p 157 N87-20638
planning of research carried out from spacecraft	Customer Servicing Facility [AIAA PAPER 87-1623] p 52 A87-43122	Data management panel report Columbus polar
p 160 N87-29553	[AIAA PAPER 87-1623] p 52 A87-43122 POINTING CONTROL SYSTEMS	platforms p 114 N87-20639
PLANTS (BOTANY) Science and payload options for animal and plant	Robust controller synthesis for a large flexible space	The orbit configuration panel report Columbus polar
research accommodations aboard the early Space	antenna p 84 A87-32235	platforms p 157 N87-20640
Station	Configuration tradeoffs for the space infrared telescope	Panel report on the polar platform servicing approach
[SAE PAPER 860953] p 164 A87-38740	facility pointing control system p 121 A87-32236	and its implications Columbus space station
Plant and animal accommodation for Space Station	Precise pointing control of flexible spacecraft	p 136 N87-20641
Laboratory	p 55 A87-32446	The Radarsat Modular Opto-electronic Multispectral
[SAE PAPER 860975] p 124 A87-38757	Low-authority control through passive damping	Scanner (R-MOMS): A potential candidate for the Polar
A method of variable spacing for controlled plant growth	[AAS PAPER 86-004] p 55 A87-32730	Orbiting Platform (POP) also
systems in spaceflight and terrestrial agriculture	The Softmounted Inertially Reacting Pointing System	[MBB-UR-873/86] p 130 N87-25506
applications	(SIRPNT)	Documentation for the SHADO particle wake routine [AD-A181531] p 131 N87-26967
[NASA-CR-177447] p 130 N87-25767	[AAS PAPER 86-007] p 56 A87-32732	
TO A COLOR A COST EDATORS	Space Infrared Telescope Facility/Multimission Modular	POLICIES

[AAS PAPER 86-007] p 56 A87-32732
Space Infrared Telescope Facility/Multimission Modular
Spacecraft Attitude Control System conceptual design
[AAS PAPER 86-031] p 56 A87-32736

POLICIES

Space research - At a crossroads

p 166 A87-32017

PLASMA ACCELERATORS

Micrometeorite exposure of solar arrays

p 82 N87-28982

Space Station program in a long-range space	POWER FACTOR CONTROLLERS	PROJECTION
development scenario of Japan p 145 A87-32530	Resistojet control and power for high frequency ac	Single-mode projection filters for identification and state
National space transportation studies [SAE PAPER 861681] p 160 A87-32598	buses [AIAA PAPER 87-0994] p 58 A87-41103	estimation of flexible structures [AIAA PAPER 87-2387] p 24 A87-50471
[SAE PAPER 861681] p 160 A87-32598 Priorities and policy analysis - A response to Alex	Resistojet control and power for high frequency ac	[AIAA PAPER 87-2387] p 24 A87-50471 Reduced-order compensation - LQG reduction versus
Roland policy analysis - A response to Alex	buses	optimal projection
The Space Station: A personal journey Book	[NASA-TM-89860] p 63 N87-20477	[AIAA PAPER 87-2388] p 61 A87-50472
p 169 A87-46975	Space station electrical power distribution analysis using	PROPELLANT STORAGE
POLITICS	a load flow approach p 80 N87-26699 POWER SUPPLY CIRCUITS	Evaluation of cryogenic system test options for the OTV
Reconstituting the US space programme	Power management equipment for space applications	on-orbit propellant depot [AIAA PAPER 87-1498] p 90 A87-43027
p 168 A87-41218	[SAE PAPER 861621] p 74 A87-32578	[AIAA PAPER 87-1498] p 90 A87-43027 PROPELLANT TANKS
Leadership in space transportation	POYNTING THEOREM	Demands imposed on a surface tension propellant tank
p 170 A87-53989 POLYBUTADIENE	Studies in nonlinear structural dynamics: Chaotic	due to refuellability in the microgravity environment of outer
Reactions of atomic oxygen (O(P-3)) with polybutadienes	behavior and poynting effect p 26 N87-20348	space
and related polymers p 109 N87-26197	PRECIPITATION (METEOROLOGY)  Observation of precipitation from space by the weather	[DGLR PAPER 86-104] p 88 A87-36756
POLYCRYSTALS	radar p 145 A87-32507	Operation of the orbital spacecraft consumables resupply system (OSCRS) at the Space Station
Frequency dispersion in the admittance of the	PREDICTION ANALYSIS TECHNIQUES	[AIAA PAPER 87-1768] p 135 A87-45192
polycrystalline Cu2S/CdS solar cell p 5 A87-29133	Experimental characterization of deployable trusses and	Liquid propellant tank ullage bubble deformation and
POLYESTER RESINS  Aromatic polyester polysiloxane block copolymers:	joints p 33 N87-22749 Investigation for damping design and related nonlinear	breakup in low gravity reorientation
Multiphase transparent damping materials	vibrations of spacecraft structures	[AIAA PAPER 87-2021] p 92 A87-45360 Propellant tank resupply system
[AD-A182623] p 110 N87-27809	[EMSB-64/85] p 35 N87-24516	[AD-D012559] p 93 N87-20375
POLYETHER RESINS	PREDICTIONS	PROPELLANT TESTS
PEEK (Polyether ether ketone) with 30 percent of carbon	Technology projections and space systems	Space station propulsion test bed: A complete system
fibres for injection molding p 22 A87-44588 POLYETHYLENES	opportunities for the 2000-2030 time period [AAS PAPER 86-109] p 2 A87-53086	p 98 N87-26131
Potential surfaces for O atom-polymer reactions	[AAS PAPER 86-109] p 2 A87-53086 Toward the year 2000: The near future of the American	PROPELLANT TRANSFER
p 109 N87-26201	civilian and military space programs	Transferring superfluid helium in space p 88 A87-34712
POLYIMIDES	[DE87-006467] p 171 N87-22697	Modeling of fluid transfer in orbit
Oxidation protection coatings for polymers	PRESSURE PULSES	[AIAA PAPER 87-1763] p 90 A87-45190
[NASA-CASE-LEW-14072-3] p 107 N87-23736	Dynamical response to pulse excitations in large space	Thermodynamic analysis and subscale modeling of
Laboratory studies of atomic oxygen reactions with solids p 4 N87-26185	structures [AIAA PAPER 87-0710] p 15 A87-33658	space-based orbit transfer vehicle cryogenic propellant
Surface modification to minimise the electrostatic	PRESSURIZED CABINS	resupply [AIAA PAPER 87-1764] p 92 A87-48572
charging of Kapton in the space environment	Servicing of user payload equipment in the Space Station	[AIAA PAPER 87-1764] p 92 A87-48572 Overview: Fluid acquisition and transfer
p 87 N87-26959	pressurized environment	p 94 N87-21146
POLYMERIC FILMS	[SAE PAPER 860973] p 134 A87-38755	Thermodynamic analysis and subscale modeling of
Structure-property relationships in polymer resistance	Columbus pressurized modules p 153 A87-46945 The hardware/software architecture of the Columbus	space-based orbit transfer vehicle cryogenic propellant
to atomic oxygen p 106 A87-38642 Laboratory studies of atomic oxygen reactions with	pressurized module element	resupply
solids p 4 N87-26185	[AIAA PAPER 87-2211] p 154 A87-48596	[NASA-TM-89921] p 96 N87-22949 An analysis of bipropellant neutralization for spacecraft
Reactions of atomic oxygen (O(P-3)) with polybutadienes	PRESSURIZING	refueling operations p 97 N87-25888
and related polymers p 109 N87-26197	Physiological requirements and pressure control of a	A study of fluid transfer management in space
Effects on advanced materials: Results of the STS-8	spaceplane	[FTMS-RPT-006] p 97 N87-26058
EOIM (Effects of Oxygen Interaction with Materials) experiment	[SAE PAPER 860965] p 150 A87-38747 PRESTRESSING	PROPELLANTS
[AD-A182931] p 110 N87-29709	Preloadable vector sensitive latch	Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135
POLYMERS	[NASA-CASE-MSC-20910-1] p 161 N87-25582	PROPULSION SYSTEM CONFIGURATIONS
Oxidation protection coatings for polymers	PRIMARY BATTERIES	The single-stage reusable ballistic launcher concept for
[NASA-CASE-LEW-14072-3] p 107 N87-23736	Advanced fuel cell concepts for future NASA missions	economic cargo transportation p 135 A87-41573
Potential energy surfaces for atomic oxygen reactions:	p 99 N87-29930	Status and tendencies for low to medium thrust
Formation of singlet and triplet hiradicals as primary		
Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules	PROBLEM SOLVING	propulsion systems
reaction products with unsaturated organic molecules p 108 N87-26182	Experiences with the Lanczos method on a parallel	[IAF PAPER 86-162] p 90 A87-42680
reaction products with unsaturated organic molecules p 108 N87-26182 Potential surfaces for O atom-polymer reactions	Experiences with the Lanczos method on a parallel computer p 21 A87-41159	
reaction products with unsaturated organic molecules p 108 N87-26182 Potential surfaces for O atom-polymer reactions p 109 N87-26201	Experiences with the Lanczos method on a parallel	[IAF PAPER 86-162] p 90 A87-42680 Thermal design of a large spacecraft propulsion system [AIAA PAPER 87-1863] p 44 A87-45258
reaction products with unsaturated organic molecules p 108 N87-26182 Potential surfaces for O atom-polymer reactions p 109 N87-26201 Comments on the interaction of materials with atomic	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing	[IAF PAPER 86-162] p 90 A87-42680 Thermal design of a large spacecraft propulsion system [AIAA PAPER 87-1863] p 44 A87-45258 Space station propulsion system technology
reaction products with unsaturated organic molecules p 108 N87-26182 Potential surfaces for O atom-polymer reactions p 109 N87-26201 Comments on the interaction of materials with atomic oxygen p 110 N87-26206	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing  [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY)  Process control and data acquisition for commercial	[IAF PAPER 86-162] p 90 A87-42680 Thermal design of a large spacecraft propulsion system [AIAA PAPER 87-1863] p 44 A87-45258 Space station propulsion system technology [NASA-TM-100108] p 97 N87-25422
reaction products with unsaturated organic molecules p 108 N87-26182  Potential surfaces for O atom-polymer reactions p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PORTABLE LIFE SUPPORT SYSTEMS	Experiences with the Lanczos method on a parallel computer p 21 A87-41159 Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY) Process control and data acquisition for commercial materials processing in space	[IAF PAPER 86-162] p 90 A87-42680 Thermal design of a large spacecraft propulsion system [AIAA PAPER 87-1863] p 44 A87-45258 Space station propulsion system technology [NASA-TM-100108] p 97 N87-25422 Propulsion recommendations for space station free
reaction products with unsaturated organic molecules p 108 N87-26182  Potential surfaces for O atom-polymer reactions p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PORTABLE LIFE SUPPORT SYSTEMS  Regenerable non-venting thermal control subsystem for extravehicular activity	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY)  Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583	[IAF PAPER 86-162] p 90 A87-42680 Thermal design of a large spacecraft propulsion system [AIAA PAPER 87-1863] p 44 A87-45258 Space station propulsion system technology [NASA-TM-100108] p 97 N87-25422 Propulsion recommendations for space station free flying platforms p 98 N87-26129
reaction products with unsaturated organic molecules p 108 N87-26182  Potential surfaces for O atom-polymer reactions p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PORTABLE LIFE SUPPORT SYSTEMS  Regenerable non-venting thermal control subsystem for extravehicular activity [SAE PAPER 860947] p 42 A87-38734	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY)  Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583  PRODUCT DEVELOPMENT	[IAF PAPER 86-162] p 90 A87-42680 Thermal design of a large spacecraft propulsion system [AIAA PAPER 87-1863] p 44 A87-45258 Space station propulsion system technology [NASA-TM-100108] p 97 N87-25422 Propulsion recommendations for space station free flying platforms p 98 N87-26129 Nuclear propulsion systems for orbit transfer based on the particle bed reactor
reaction products with unsaturated organic molecules p 108 M87-26182  Potential surfaces for O atom-polymer reactions p 109 M87-26201  Comments on the interaction of materials with atomic oxygen p 110 M87-26206  PORTABLE LIFE SUPPORT SYSTEMS  Regenerable non-venting thermal control subsystem for extravehicular activity  [SAE PAPER 860947] p 42 A87-38734  Evaluation of regenerative portable life support system	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY)  Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583	Thermal design of a large spacecraft propulsion system [AIAA PAPER 87-1863] p 44 A87-45258 Space station propulsion system technology [NASA-TM-100108] p 97 N87-25422 Propulsion recommendations for space station free flying platforms p 98 N87-26129 Nuclear propulsion systems for orbit transfer based on the particle bed reactor [DE87-010060] p 99 N87-28405
reaction products with unsaturated organic molecules p 108 N87-26182  Potential surfaces for O atom-polymer reactions p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PORTABLE LIFE SUPPORT SYSTEMS  Regenerable non-venting thermal control subsystem for extravehicular activity [SAE PAPER 860947] p 42 A87-38734	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY)  Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583  PRODUCT DEVELOPMENT  A microgravity isolation mount p 161 N87-29861  PRODUCTION COSTS  Space Station EVA systems trade-off model	Thermal design of a large spacecraft propulsion system [AIAA PAPER 87-1863] p 44 A87-45258 Space station propulsion system technology [NASA-TM-100108] p 97 N87-25422 Propulsion recommendations for space station free flying platforms p 98 N87-26129 Nuclear propulsion systems for orbit transfer based on the particle bed reactor [DE87-010060] p 99 N87-28405 PROPULSION SYSTEM PERFORMANCE
reaction products with unsaturated organic molecules p 108 M87-26182  Potential surfaces for O atom-polymer reactions p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PORTABLE LIFE SUPPORT SYSTEMS  Regenerable non-venting thermal control subsystem for extravehicular activity  [SAE PAPER 860947] p 42 A87-38734  Evaluation of regenerative portable life support system options  [SAE PAPER 860948] p 49 A87-38735  POSITIVE FEEDBACK	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY)  Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583  PRODUCT DEVELOPMENT  A microgravity isolation mount p 161 N87-29861  PRODUCTION COSTS  Space Station EVA systems trade-off model [SAE PAPER 860990] p 134 A87-38767	Thermal design of a large spacecraft propulsion system [AIAA PAPER 87-1863] p 44 A87-45258 Space station propulsion system technology [NASA-TM-100108] p 97 N87-25422 Propulsion recommendations for space station free flying platforms p 98 N87-26129 Nuclear propulsion systems for orbit transfer based on the particle bed reactor [DE87-010060] p 99 N87-28405
reaction products with unsaturated organic molecules p 108 N87-26182  Potential surfaces for O atom-polymer reactions p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PORTABLE LIFE SUPPORT SYSTEMS  Regenerable non-venting thermal control subsystem for extravehicular activity  [SAE PAPER 860947] p 42 A87-38734  Evaluation of regenerative portable life support system options  [SAE PAPER 860948] p 49 A87-38735  POSITIVE FEEDBACK  Robust multivariable control of large space structures	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY)  Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583  PRODUCT DEVELOPMENT  A microgravity isolation mount p 161 N87-29861  PRODUCTION COSTS  Space Station EVA systems trade-off model [SAE PAPER 860990] p 134 A87-38767  PROGNOZ SATELLITES	[IAF PAPER 86-162] p 90 A87-42680 Thermal design of a large spacecraft propulsion system [AIAA PAPER 87-1863] p 44 A87-45258 Space station propulsion system technology [NASA-TM-100108] p 97 N87-25422 Propulsion recommendations for space station free flying platforms p 98 N87-26129 Nuclear propulsion systems for orbit transfer based on the particle bed reactor [DE87-010060] p 99 N87-28405 PROPULSION SYSTEM PERFORMANCE Advanced propulsion activities in the USA
reaction products with unsaturated organic molecules p 108 N87-26182  Potential surfaces for O atom-polymer reactions p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PORTABLE LIFE SUPPORT SYSTEMS  Regenerable non-venting thermal control subsystem for extravehicular activity  [SAE PAPER 860947] p 42 A87-38734  Evaluation of regenerative portable life support system options  [SAE PAPER 860948] p 49 A87-38735  POSITIVE FEEDBACK  Robust multivariable control of large space structures using positivity p 59 A87-47810	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY)  Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583  PRODUCT DEVELOPMENT  A microgravity isolation mount p 161 N87-29861  PRODUCTION COSTS  Space Station EVA systems trade-off model [SAE PAPER 880990] p 134 A87-38767  PROGNOZ SATELLITES  The Signe II gamma-ray burst experiment aboard the	Thermal design of a large spacecraft propulsion system  [AIAA PAPER 87-1863] p 44 A87-45258  Space station propulsion system technology  [NASA-TM-100108] p 97 N87-25422  Propulsion recommendations for space station free flying platforms p 98 N87-26129  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE87-010060] p 99 N87-28405  PROPULSION SYSTEM PERFORMANCE  Advanced propulsion activities in the USA p 90 A87-41575  NERVA derived nuclear orbit transfer system  [AIAA PAPER 87-2155] p 92 A87-45439
reaction products with unsaturated organic molecules p 108 M87-26182 Potential surfaces for O atom-polymer reactions p 109 N87-26201 Comments on the interaction of materials with atomic oxygen p 110 N87-26206 PORTABLE LIFE SUPPORT SYSTEMS Regenerable non-venting thermal control subsystem for extravehicular activity [SAE PAPER 860947] p 42 A87-38734 Evaluation of regenerative portable life support system options [SAE PAPER 860948] p 49 A87-38735 POSITIVE FEEDBACK Robust multivariable control of large space structures using positivity An experimental investigation of vibration suppression	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY)  Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583  PRODUCT DEVELOPMENT  A microgravity isolation mount p 161 N87-29861  PRODUCTION COSTS  Space Station EVA systems trade-off model [SAE PAPER 860990] p 134 A87-38767  PROGNOZ SATELLITES  The Signe II gamma-ray burst experiment aboard the Prognoz 9 satellite p 150 A87-38443	Thermal design of a large spacecraft propulsion system  [AIAA PAPER 87-1863] p 44 A87-45258  Space station propulsion system technology  [NASA-TM-100108] p 97 N87-25422  Propulsion recommendations for space station free flying platforms p 98 N87-26129  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE87-010060] p 99 N87-28405  PROPULSION SYSTEM PERFORMANCE  Advanced propulsion activities in the USA p 90 A87-41575  NERVA derived nuclear orbit transfer system  [AIAA PAPER 87-2155] p 92 A87-45439  Propulsion recommendations for space station free
reaction products with unsaturated organic molecules p 108 N87-26182  Potential surfaces for O atom-polymer reactions p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PORTABLE LIFE SUPPORT SYSTEMS  Regenerable non-venting thermal control subsystem for extravehicular activity  [SAE PAPER 860947] p 42 A87-38734  Evaluation of regenerative portable life support system options  [SAE PAPER 860948] p 49 A87-38735  POSITIVE FEEDBACK  Robust multivariable control of large space structures using positivity p 59 A87-47810	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY)  Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583  PRODUCT DEVELOPMENT  A microgravity isolation mount p 161 N87-29861  PRODUCTION COSTS  Space Station EVA systems trade-off model [SAE PAPER 860990] p 134 A87-38767  PROGNOZ SATELLITES  The Signe II gamma-ray burst experiment aboard the Prognoz 9 satellite  PROGRAM VERIFICATION (COMPUTERS)	Thermal design of a large spacecraft propulsion system [AIAA PAPER 87-1863] p 44 A87-45258 Space station propulsion system technology [NASA-TM-100108] p 97 N87-25422 Propulsion recommendations for space station free flying platforms p 98 N87-26129 Nuclear propulsion systems for orbit transfer based on the particle bed reactor [DE87-010060] p 99 N87-28405 PROPULSION SYSTEM PERFORMANCE Advanced propulsion activities in the USA p 90 A87-41575 NERVA derived nuclear orbit transfer system [AIAA PAPER 87-2155] p 92 A87-45439 Propulsion recommendations for space station free flying platforms p 98 N87-26129
reaction products with unsaturated organic molecules p 108 M87-26182 Potential surfaces for O atom-polymer reactions p 109 N87-26201 Comments on the interaction of materials with atomic oxygen p 110 N87-26206 PORTABLE LIFE SUPPORT SYSTEMS Regenerable non-venting thermal control subsystem for extravehicular activity [SAE PAPER 860947] p 42 A87-38734 Evaluation of regenerative portable life support system options [SAE PAPER 860948] p 49 A87-38735 POSITIVE FEEDBACK Robust multivariable control of large space structures using positivity p 59 A87-47810 An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937 POSTLAUNCH REPORTS	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY)  Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583  PRODUCT DEVELOPMENT  A microgravity isolation mount p 161 N87-29861  PRODUCTION COSTS  Space Station EVA systems trade-off model [SAE PAPER 860990] p 134 A87-38767  PROGNOZ SATELLITES  The Signe II gamma-ray burst experiment aboard the Prognoz 9 satellite p 150 A87-38443  PROGRAM VERIFICATION (COMPUTERS)  Space station data management system - A common	Thermal design of a large spacecraft propulsion system  [AIAA PAPER 87-1863] p 44 A87-45258  Space station propulsion system technology  [NASA-TM-100108] p 97 N87-25422  Propulsion recommendations for space station free flying platforms p 98 N87-26129  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE97-010060] p 99 N87-28405  PROPULSION SYSTEM PERFORMANCE  Advanced propulsion activities in the USA p 90 A87-41575  NERVA derived nuclear orbit transfer system  [AIAA PAPER 87-2155] p 92 A87-45439  Propulsion recommendations for space station free flying platforms p 98 N87-26129  A 25-LBF gaseous oxygen/gaseous hydrogen thruster
reaction products with unsaturated organic molecules p 108 N87-26182  Potential surfaces for O atom-polymer reactions p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PORTABLE LIFE SUPPORT SYSTEMS  Regenerable non-venting thermal control subsystem for extravehicular activity  [SAE PAPER 860947] p 42 A87-38734  Evaluation of regenerative portable life support system options  [SAE PAPER 860948] p 49 A87-38735  POSITIVE FEEDBACK  Robust multivariable control of large space structures using positivity p 59 A87-47810  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937  POSTLAUNCH REPORTS  SPOT solar array in-orbit deployment results	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY)  Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583  PRODUCT DEVELOPMENT  A microgravity isolation mount p 161 N87-29861  PRODUCTION COSTS  Space Station EVA systems trade-off model [SAE PAPER 860990] p 134 A87-38767  PROGNOZ SATELLITES  The Signe II gamma-ray burst experiment aboard the Prognoz 9 satellite  PROGRAM VERIFICATION (COMPUTERS)	Thermal design of a large spacecraft propulsion system  [AIAA PAPER 87-1863] p 44 A87-45258  Space station propulsion system technology  [NASA-TM-100108] p 97 N87-25422  Propulsion recommendations for space station free flying platforms p 98 N87-26129  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE87-010060] p 99 N87-28405  PROPULSION SYSTEM PERFORMANCE  Advanced propulsion activities in the USA p 90 A87-41575  NERVA derived nuclear orbit transfer system  [AIAA PAPER 87-2155] p 92 A87-45439  Propulsion recommendations for space station free flying platforms p 98 N87-26129  A 25-LBF gaseous oxygen/gaseous hydrogen thruster for space station application p 98 N87-26129
reaction products with unsaturated organic molecules p 108 N87-26182  Potential surfaces for O atom-polymer reactions p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PORTABLE LIFE SUPPORT SYSTEMS  Regenerable non-venting thermal control subsystem for extravehicular activity  [SAE PAPER 860947] p 42 A87-38734  Evaluation of regenerative portable life support system options  [SAE PAPER 860948] p 49 A87-38735  POSITIVE FEEDBACK  Robust multivariable control of large space structures using positivity p 59 A87-47810  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937  POSITIAUNCH REPORTS  SPOT solar array in-orbit deployment results evaluation p 83 N87-28986	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY)  Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583  PRODUCT DEVELOPMENT  A microgravity isolation mount p 161 N87-29861  PRODUCTION COSTS  Space Station EVA systems trade-off model [SAE PAPER 860990] p 134 A87-38767  PROGNOZ SATELLITES  The Signe II gamma-ray burst experiment aboard the Prognoz 9 satellite p 150 A87-38443  PROGRAM VERIFICATION (COMPUTERS)  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  PROGRAMMING LANGUAGES	Thermal design of a large spacecraft propulsion system  [AIAA PAPER 87-1863] p 44 A87-45258  Space station propulsion system technology  [NASA-TM-100108] p 97 N87-25422  Propulsion recommendations for space station free flying platforms p 98 N87-26129  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE67-010060] p 99 N87-28405  PROPULSION SYSTEM PERFORMANCE  Advanced propulsion activities in the USA p 90 A87-41575  NERVA derived nuclear orbit transfer system p 92 A87-45439  Propulsion recommendations for space station free flying platforms p 98 N87-26129  A 25-LBF gaseous oxygen/gaseous hydrogen thruster for space station application p 98 N87-26132  Nuclear propulsion systems for orbit transfer based on the particle bed reactor
reaction products with unsaturated organic molecules p 108 N87-28182  Potential surfaces for O atom-polymer reactions p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PORTABLE LIFE SUPPORT SYSTEMS  Regenerable non-venting thermal control subsystem for extravehicular activity  [SAE PAPER 860947] p 42 A87-38734  Evaluation of regenerative portable life support system options  [SAE PAPER 860948] p 49 A87-38735  POSITIVE FEEDBACK  Robust multivariable control of large space structures using positivity p 59 A87-47810  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937  POSTLAUNCH REPORTS  SPOT solar array in-orbit deployment results evaluation p 83 N87-28986	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY) Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583  PRODUCT DEVELOPMENT A microgravity isolation mount p 161 N87-29861  PRODUCTION COSTS Space Station EVA systems trade-off model [SAE PAPER 880990] p 134 A87-38767  PROGNOZ SATELLITES The Signe II gamma-ray burst experiment aboard the Prognoz 9 satellite p 150 A87-38443  PROGRAM VERIFICATION (COMPUTERS) Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  PROGRAMMING LANGUAGES KSC Space Station Operations Language (SSOL)	Thermal design of a large spacecraft propulsion system  [AIAA PAPER 87-1863] p 44 A87-45258  Space station propulsion system technology  [NASA-TM-100108] p 97 N87-25422  Propulsion recommendations for space station free flying platforms p 98 N87-26129  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE87-010060] p 99 N87-28405  PROPULSION SYSTEM PERFORMANCE  Advanced propulsion activities in the USA p 90 A87-41575  NERVA derived nuclear orbit transfer system  [AIAA PAPER 87-2155] p 92 A87-45439  Propulsion recommendations for space station free flying platforms p 98 N87-26129  A 25-LBF gaseous oxygen/gaseous hydrogen thruster for space station application p 98 N87-26132  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE87-010060] p 99 N87-28405
reaction products with unsaturated organic molecules p 108 N87-26182  Potential surfaces for O atom-polymer reactions p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PORTABLE LIFE SUPPORT SYSTEMS  Regenerable non-venting thermal control subsystem for extravehicular activity  [SAE PAPER 860947] p 42 A87-38734  Evaluation of regenerative portable life support system options  [SAE PAPER 860948] p 49 A87-38735  POSITIVE FEEDBACK  Robust multivariable control of large space structures using positivity p 59 A87-47810  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937  POSTLAUNCH REPORTS  SPOT solar array in-orbit deployment results evaluation p 83 N87-28986  POTABLE WATER  Development of a water recovery subsystem based on	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY)  Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583  PRODUCT DEVELOPMENT  A microgravity isolation mount p 161 N87-29861  PRODUCTION COSTS  Space Station EVA systems trade-off model [SAE PAPER 860990] p 134 A87-38767  PROGNOZ SATELLITES  The Signe Il gamma-ray burst experiment aboard the Prognoz 9 satellite p 150 A87-38443  PROGRAM VERIFICATION (COMPUTERS)  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  PROGRAMMING LANGUAGES  KSC Space Station Operations Language (SSCL) p 138 N87-29168	Thermal design of a large spacecraft propulsion system  [AIAA PAPER 87-1863] p. 44 A87-45258  Space station propulsion system technology  [NASA-TM-100108] p. 97 N87-25422  Propulsion recommendations for space station free flying platforms p. 98 N87-26129  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE87-010060] p. 99 N87-28405  PROPULSION SYSTEM PERFORMANCE  Advanced propulsion activities in the USA  p. 90 A87-41575  NERVA derived nuclear orbit transfer system  [AIAA PAPER 87-2155] p. 92 A87-45439  Propulsion recommendations for space station free flying platforms p. 98 N87-26129  A 25-LBF gaseous oxygen/gaseous hydrogen thruster for space station application p. 98 N87-26132  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE87-010060] p. 99 N87-28405  PROPULSIVE EFFICIENCY
reaction products with unsaturated organic molecules p 108 N87-26182 Potential surfaces for O atom-polymer reactions  p 109 N87-26201 Comments on the interaction of materials with atomic oxygen p 110 N87-26206 PORTABLE LIFE SUPPORT SYSTEMS Regenerable non-venting thermal control subsystem for extravehicular activity [SAE PAPER 860947] p 42 A87-38734 Evaluation of regenerative portable life support system options [SAE PAPER 860948] p 49 A87-38735 POSITIVE FEEDBACK Robust multivariable control of large space structures using positivity p 59 A87-47810 An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937 POSTLAUNCH REPORTS SPOT solar array in-orbit deployment results evaluation p 83 N87-28986 POTABLE WATER Development of a water recovery subsystem based on Vapor Phase Catalytic Ammonia Removal (VPCAR) [SAE PAPER 860985] p 50 A87-38764	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY)  Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583  PRODUCT DEVELOPMENT  A microgravity isolation mount p 161 N87-29861  PRODUCTION COSTS  Space Station EVA systems trade-off model [SAE PAPER 860990] p 134 A87-38767  PROGNOZ SATELLITES  The Signe II gamma-ray burst experiment aboard the Prognoz 9 satellite p 150 A87-38443  PROGRAM VERIFICATION (COMPUTERS)  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  PROGRAMMING LANGUAGES  KSC Space Station Operations Language (SSOL) p 138 N87-29168	Thermal design of a large spacecraft propulsion system  [AIAA PAPER 87-1863] p 44 A87-45258  Space station propulsion system technology  [NASA-TM-100108] p 97 N87-25422  Propulsion recommendations for space station free flying platforms p 98 N87-26129  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE67-010060] p 99 N87-28405  PROPULSION SYSTEM PERFORMANCE  Advanced propulsion activities in the USA p 90 A87-41575  NERVA derived nuclear orbit transfer system p 92 A87-45439  Propulsion recommendations for space station free flying platforms p 98 N87-26129  A 25-LBF gaseous oxygen/gaseous hydrogen thruster for space station application p 98 N87-26132  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE67-010060] p 99 N87-28405  PROPULSIVE EFFICIENCY  Nuclear reactor power for an electrically powered orbital
reaction products with unsaturated organic molecules p 108 N87-26182  Potential surfaces for O atom-polymer reactions p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PORTABLE LIFE SUPPORT SYSTEMS  Regenerable non-venting thermal control subsystem for extravehicular activity  [SAE PAPER 860947] p 42 A87-38734  Evaluation of regenerative portable life support system options  [SAE PAPER 860948] p 49 A87-38735  POSITIVE FEEDBACK  Robust multivariable control of large space structures using positivity p 59 A87-47810  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937  POSTLAUNCH REPORTS  SPOT solar array in-orbit deployment results evaluation p 83 N87-28986  POTABLE WATER  Development of a water recovery subsystem based on Vapor Phase Catalytic Ammonia Removal (VPCAR)  [SAE PAPER 860985] p 50 A87-38764  Quality requirements for reclaimed/recycled water	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY)  Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583  PRODUCT DEVELOPMENT  A microgravity isolation mount p 161 N87-29861  PRODUCTION COSTS  Space Station EVA systems trade-off model [SAE PAPER 860990] p 134 A87-38767  PROGNOZ SATELLITES  The Signe II gamma-ray burst experiment aboard the Prognoz 9 satellite p 150 A87-38443  PROGRAM VERIFICATION (COMPUTERS)  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  PROGRAMMING LANGUAGES  KSC Space Station Operations Language (SSOL) p 138 N87-29168  PROJECT MANAGEMENT  The Space Station - Work Package 3	Thermal design of a large spacecraft propulsion system  [AIAA PAPER 87-1863] p 44 A87-45258  Space station propulsion system technology  [NASA-TM-100108] p 97 N87-25422  Propulsion recommendations for space station free flying platforms p 98 N87-26129  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE87-010060] p 99 N87-28405  PROPULSION SYSTEM PERFORMANCE  Advanced propulsion activities in the USA p 90 A87-41575  NERVA derived nuclear orbit transfer system  [AIAA PAPER 87-2155] p 92 A87-45439  Propulsion recommendations for space station free flying platforms p 98 N87-26129  A 25-LBF gaseous oxygen/gaseous hydrogen thruster for space station application p 98 N87-26129  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE87-010060] p 99 N87-28405  PROPULSIVE EFFICIENCY  Nuclear reactor power for an electrically powered orbital transfer vehicle
reaction products with unsaturated organic molecules p 108 N87-26182  Potential surfaces for O atom-polymer reactions p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PORTABLE LIFE SUPPORT SYSTEMS  Regenerable non-venting thermal control subsystem for extravehicular activity  [SAE PAPER 860947] p 42 A87-38734  Evaluation of regenerative portable life support system options  [SAE PAPER 860948] p 49 A87-38735  POSITIVE FEEDBACK  Robust multivariable control of large space structures using positivity p 59 A87-47810  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937  POSITIAUNCH REPORTS  SPOT solar array in-orbit deployment results evaluation p 83 N87-28986  POTABLE WATER  Development of a water recovery subsystem based on Vapor Phase Catalytic Ammonia Removal (VPCAR)  [SAE PAPER 860985] p 50 A87-38764  Quality requirements for reclaimed/recycled water  [NASA-TM-58279] p 53 N87-27992	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY)  Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583  PRODUCT DEVELOPMENT  A microgravity isolation mount p 161 N87-29861  PRODUCTION COSTS  Space Station EVA systems trade-off model [SAE PAPER 860990] p 134 A87-38767  PROGNOZ SATELLITES  The Signe II gamma-ray burst experiment aboard the Prognoz 9 satellite p 150 A87-38443  PROGRAM VERIFICATION (COMPUTERS)  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  PROGRAMMING LANGUAGES  KSC Space Station Operations Language (SSOL) p 138 N87-29168	Thermal design of a large spacecraft propulsion system  [AIAA PAPER 87-1863] p 44 A87-45258  Space station propulsion system technology  [NASA-TM-100108] p 97 N87-25422  Propulsion recommendations for space station free flying platforms p 98 N87-26129  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE67-010060] p 99 N87-28405  PROPULSION SYSTEM PERFORMANCE  Advanced propulsion activities in the USA p 90 A87-41575  NERVA derived nuclear orbit transfer system  [AIAA PAPER 87-2155] p 92 A87-45439  Propulsion recommendations for space station free flying platforms p 98 N87-28129  A 25-LBF gaseous oxygen/gaseous hydrogen thruster for space station application p 98 N87-28129  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE67-010060] p 99 N87-28405  PROPULSIVE EFFICIENCY  Nuclear reactor power for an electrically powered orbital transfer vehicle  [AIAA PAPER 87-1102] p 76 A87-41145  Density uncertainty effect on cost of space station
reaction products with unsaturated organic molecules p 108 N87-28182  Potential surfaces for O atom-polymer reactions p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PORTABLE LIFE SUPPORT SYSTEMS  Regenerable non-venting thermal control subsystem for extravehicular activity  [SAE PAPER 860947] p 42 A87-38734  Evaluation of regenerative portable life support system options  [SAE PAPER 860948] p 49 A87-38735  POSITIVE FEEDBACK  Robust multivariable control of large space structures using positivity p 59 A87-47810  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937  POSTLAUNCH REPORTS  SPOT solar array in-orbit deployment results evaluation p 83 N87-28986  POTABLE WATER  Development of a water recovery subsystem based on Vapor Phase Catalytic Ammonia Removal (VPCAR)  [SAE PAPER 860985] p 50 A87-38764  Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 50 N87-27392	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY)  Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583  PRODUCT DEVELOPMENT  A microgravity isolation mount p 161 N87-29861  PRODUCTION COSTS  Space Station EVA systems trade-off model [SAE PAPER 860990] p 134 A87-38767  PROGNOZ SATELLITES  The Signe II gamma-ray burst experiment aboard the Prognoz 9 satellite p 150 A87-38443  PROGRAM VERIFICATION (COMPUTERS)  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  PROGRAMMING LANGUAGES  KSC Space Station Operations Language (SSOL) p 138 N87-29168  PROJECT MANAGEMENT  The Space Station - Work Package 3 p 118 A87-32529  USA-Europe coordination and cooperation activities: Announcements of Opportunity polar platforms	Thermal design of a large spacecraft propulsion system  [AIAA PAPER 87-1863] p 44 A87-45258  Space station propulsion system technology  [NASA-TM-100108] p 97 N87-25422  Propulsion recommendations for space station free flying platforms p 98 N87-26129  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE87-010060] p 99 N87-28405  PROPULSION SYSTEM PERFORMANCE  Advanced propulsion activities in the USA p 90 A87-41575  NERVA derived nuclear orbit transfer system  [AIAA PAPER 87-2155] p 92 A87-45439  Propulsion recommendations for space station free flying platforms p 98 N87-26129  A 25-LBF gaseous oxygen/gaseous hydrogen thruster for space station application p 98 N87-26132  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE87-010060] p 99 N87-28405  PROPULSIVE EFFICIENCY  Nuclear reactor power for an electrically powered orbital transfer vehicle  [AIAA PAPER 87-1102] p 76 A87-41145  Density uncertainty effect on cost of space station reboost p 170 N87-20667
reaction products with unsaturated organic molecules p 108 N87-26182  Potential surfaces for O atom-polymer reactions p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PORTABLE LIFE SUPPORT SYSTEMS  Regenerable non-venting thermal control subsystem for extravehicular activity  [SAE PAPER 860947] p 42 A87-38734  Evaluation of regenerative portable life support system options  [SAE PAPER 860948] p 49 A87-38735  POSITIVE FEEDBACK  Robust multivariable control of large space structures using positivity p 59 A87-47810  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937  POSTLAUNCH REPORTS  SPOT solar array in-orbit deployment results evaluation p 83 N87-28986  POTABLE WATER  Development of a water recovery subsystem based on Vapor Phase Catalytic Ammonia Removal (VPCAR)  [SAE PAPER 860985] p 50 A87-38764  Quality requirements for reclaimed/recycled water  [NASA-TM-58279] POWER CONDITIONING  New power processor interfaces MMS power module	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY) Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583  PRODUCT DEVELOPMENT A microgravity isolation mount p 161 N87-29861  PRODUCTION COSTS Space Station EVA systems trade-off model [SAE PAPER 860990] p 134 A87-38767  PROGNOZ SATELLITES The Signe II gamma-ray burst experiment aboard the Prognoz 9 satellite p 150 A87-38443  PROGRAM VERIFICATION (COMPUTERS) Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  PROGRAMMING LANGUAGES KSC Space Station Operations Language (SSOL) p 138 N87-29168  PROJECT MANAGEMENT The Space Station - Work Package 3  USA-Europe coordination and cooperation activities: Announcements of Opportunity polar platforms p 170 N87-20632	Thermal design of a large spacecraft propulsion system  [AIAA PAPER 87-1863] p 44 A87-45258  Space station propulsion system technology  [NASA-TM-100108] p 97 N87-25422  Propulsion recommendations for space station free flying platforms p 98 N87-26129  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE87-010060] p 99 N87-28405  PROPULSION SYSTEM PERFORMANCE  Advanced propulsion activities in the USA p 90 A87-41575  NERVA derived nuclear orbit transfer system  [AIAA PAPER 87-2155] p 92 A87-45439  Propulsion recommendations for space station free flying platforms p 98 N87-26129  A 25-LBF gaseous oxygen/gaseous hydrogen thruster for space station application p 98 N87-26132  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE87-010060] p 99 N87-28405  PROPULSIVE EFFICIENCY  Nuclear reactor power for an electrically powered orbital transfer vehicle  [AIAA PAPER 87-1102] p 76 A87-41145  Density uncertainty effect on cost of space station reboost  PROTECTIVE CLOTHING
reaction products with unsaturated organic molecules p 108 N87-28182 Potential surfaces for O atom-polymer reactions p 109 N87-26201 Comments on the interaction of materials with atomic oxygen p 110 N87-26206 PORTABLE LIFE SUPPORT SYSTEMS Regenerable non-venting thermal control subsystem for extravehicular activity [SAE PAPER 860947] p 42 A87-38734 Evaluation of regenerative portable life support system options [SAE PAPER 860948] p 49 A87-38735 POSITIVE FEEDBACK Robust multivariable control of large space structures using positivity p 59 A87-47810 An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937 POSTLAUNCH REPORTS SPOT solar array in-orbit deployment results evaluation p 83 N87-28986 POTABLE WATER Development of a water recovery subsystem based on Vapor Phase Catalytic Ammonia Removal (VPCAR) [SAE PAPER 860985] p 50 A87-38764 Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 50 N87-27392 POWER CONDITIONING New power processor interfaces MMS power module outputs Multimission Modular Spacecraft	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY) Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583  PRODUCT DEVELOPMENT A microgravity isolation mount p 161 N87-29861  PRODUCTION COSTS Space Station EVA systems trade-off model [SAE PAPER 880990] p 134 A87-38767  PROGNOZ SATELLITES The Signe II gamma-ray burst experiment aboard the Prognoz 9 satellite p 150 A87-38443  PROGRAM VERIFICATION (COMPUTERS) Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  PROGRAMMING LANGUAGES KSC Space Station Operations Language (SSOL) P 138 N87-29168  PROJECT MANAGEMENT The Space Station - Work Package 3 p 118 A87-32529  USA-Europe coordination and cooperation activities: Announcements of Opportunity polar platforms p 170 N87-20632 The Columbus program p 157 N87-25031	Thermal design of a large spacecraft propulsion system  [AIAA PAPER 87-1863] p. 44 A87-45258  Space station propulsion system technology  [NASA-TM-100108] p. 97 N87-25422  Propulsion recommendations for space station free flying platforms p. 98 N87-26129  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE67-010060] p. 99 N87-28405  PROPULSION SYSTEM PERFORMANCE  Advanced propulsion activities in the USA p. 90 A87-41575  NERVA derived nuclear orbit transfer system  [AIAA PAPER 87-2155] p. 92 A87-45439  Propulsion recommendations for space station free flying platforms p. 98 N87-28129  A 25-LBF gaseous oxygen/gaseous hydrogen thruster for space station application p. 98 N87-28139  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE67-010060] p. 99 N87-28405  PROPULSIVE EFFICIENCY  Nuclear reactor power for an electrically powered orbital transfer vehicle  [AIAA PAPER 87-1102] p. 76 A87-41145  Density uncertainty effect on cost of space station reboost p. 170 N87-20667  PROTECTIVE CLOTHING  Space suit extravehicular hazards protection
reaction products with unsaturated organic molecules p 108 N87-26182  Potential surfaces for O atom-polymer reactions p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PORTABLE LIFE SUPPORT SYSTEMS  Regenerable non-venting thermal control subsystem for extravehicular activity  [SAE PAPER 860947] p 42 A87-38734  Evaluation of regenerative portable life support system options  [SAE PAPER 860948] p 49 A87-38735  POSITIVE FEEDBACK  Robust multivariable control of large space structures using positivity p 59 A87-47810  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937  POSTLAUNCH REPORTS  SPOT solar array in-orbit deployment results evaluation p 83 N87-28966  POTABLE WATER  Development of a water recovery subsystem based on Vapor Phase Catalytic Ammonia Removal (VPCAR)  [SAE PAPER 860985] p 50 A87-38764  Quality requirements for reclaimed/recycled water [NASA-TM-58279]  POWER CONDITIONING  New power processor interfaces MMS power module outputs Multimission Modular Spacecraft  p 77 A87-48264  Control considerations for high frequency, resonant,	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY)  Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583  PRODUCT DEVELOPMENT  A microgravity isolation mount p 161 N87-29861  PRODUCTION COSTS  Space Station EVA systems trade-off model [SAE PAPER 860990] p 134 A87-38767  PROGNOZ SATELLITES  The Signe II gamma-ray burst experiment aboard the Prognoz 9 satellite p 150 A87-38443  PROGRAM VERIFICATION (COMPUTERS)  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  PROGRAMMING LANGUAGES  KSC Space Station Operations Language (SSOL)  p 138 N87-29168  PROJECT MANAGEMENT  The Space Station - Work Package 3  p 118 A87-32529  USA-Europe coordination and cooperation activities: Announcements of Opportunity polar platforms  p 170 N87-20632  The Columbus program p 157 N87-25031	Thermal design of a large spacecraft propulsion system  [AIAA PAPER 87-1863] p. 44 A87-45258  Space station propulsion system technology  [NASA-TM-100108] p. 97 N87-25422  Propulsion recommendations for space station free flying platforms p. 98 N87-26129  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE37-010060] p. 99 N87-28405  PROPULSION SYSTEM PERFORMANCE  Advanced propulsion activities in the USA p. 90 A87-41575  NERVA derived nuclear orbit transfer system  [AIAA PAPER 87-2155] p. 92 A87-45439  Propulsion recommendations for space station free flying platforms p. 98 N87-26129  A 25-LBF gaseous oxygen/gaseous hydrogen thruster for space station application p. 98 N87-26132  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE87-010060] p. 99 N87-28405  PROPULSIVE EFFICIENCY  Nuclear reactor power for an electrically powered orbital transfer vehicle  [AIAA PAPER 87-1102] p. 76 A87-41145  Density uncertainty effect on cost of space station reboost p. 170 N87-20667  PROTECTIVE CLOTHING  Space suit extravehicular hazards protection development  [NASA-TM-89355] p. 53 N87-27407
reaction products with unsaturated organic molecules p 108 N87-26182  Potential surfaces for O atom-polymer reactions p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PORTABLE LIFE SUPPORT SYSTEMS  Regenerable non-venting thermal control subsystem for extravehicular activity  [SAE PAPER 860947] p 42 A87-38734  Evaluation of regenerative portable life support system options  [SAE PAPER 860948] p 49 A87-38735  POSITIVE FEEDBACK  Robust multivariable control of large space structures using positivity p 59 A87-47810  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937  POSTLAUNCH REPORTS  SPOT solar array in-orbit deployment results evaluation p 83 N87-28986  POTABLE WATER  Development of a water recovery subsystem based on Vapor Phase Catalytic Ammonia Removal (VPCAR)  [SAE PAPER 860985] p 50 A87-38784  Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  POWER CONDITIONING  New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A87-48264  Control considerations for high frequency, resonant, power processing equipment used in large systems	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY) Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583  PRODUCT DEVELOPMENT A microgravity isolation mount p 161 N87-29861  PRODUCTION COSTS Space Station EVA systems trade-off model [SAE PAPER 860990] p 134 A87-38767  PROGNOZ SATELLITES The Signe II gamma-ray burst experiment aboard the Prognoz 9 satellite p 150 A87-38443  PROGRAM VERIFICATION (COMPUTERS) Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  PROGRAMMING LANGUAGES KSC Space Station Operations Language (SSOL) p 138 N87-29168  PROJECT MANAGEMENT The Space Station - Work Package 3  p 118 A87-32529  USA-Europe coordination and cooperation activities: Announcements of Opportunity polar platforms  p 170 N87-20632 The Columbus program p 157 N87-25031  PROJECT PLANNING Space station experiment definition: Long-term	Thermal design of a large spacecraft propulsion system  [AIAA PAPER 87-1863] p. 44 A87-45258  Space station propulsion system technology  [NASA-TM-100108] p. 97 N87-25422  Propulsion recommendations for space station free flying platforms p. 98 N87-26129  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE67-010060] p. 99 N87-28405  PROPULSION SYSTEM PERFORMANCE  Advanced propulsion activities in the USA p. 90 A87-41575  NERVA derived nuclear orbit transfer system  [AIAA PAPER 87-2155] p. 92 A87-45439  Propulsion recommendations for space station free flying platforms  A 25-LBF gaseous oxygen/gaseous hydrogen thruster for space station application p. 98 N87-26129  A 25-LBF gaseous oxygen/gaseous hydrogen thruster for space station application p. 98 N87-26132  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE67-010060] p. 99 N87-28405  PROPULSIVE EFFICIENCY  Nuclear reactor power for an electrically powered orbital transfer vehicle  [AIAA PAPER 87-1102] p. 76 A87-41145  Density uncertainty effect on cost of space station reboost  PROTECTIVE CLOTHING  Space suit extravehicular hazards protection development  [NASA-TM-89355] p. 53 N87-27407
reaction products with unsaturated organic molecules p 108 N87-26182  Potential surfaces for O atom-polymer reactions p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PORTABLE LIFE SUPPORT SYSTEMS  Regenerable non-venting thermal control subsystem for extravehicular activity  [SAE PAPER 860947] p 42 A87-38734  Evaluation of regenerative portable life support system options  [SAE PAPER 860948] p 49 A87-38735  POSITIVE FEEDBACK  Robust multivariable control of large space structures using positivity p 59 A87-47810  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937  POSITAUNCH REPORTS  SPOT solar array in-orbit deployment results evaluation p 83 N87-28986  POTABLE WATER  Development of a water recovery subsystem based on Vapor Phase Catalytic Ammonia Removal (VPCAR)  [SAE PAPER 860985] p 50 A87-38764  Quality requirements for reclaimed/recycled water  [NASA-TM-58279] p 53 N87-27392  POWER CONDITIONING  New power processor interfaces MMS power module outputs — Multimission Modular Spacecraft p 77 A87-48264  Control considerations for high frequency, resonant, power processing equipment used in large systems  [NASA-TM-89926] p 68 N87-23690	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY) Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583  PRODUCT DEVELOPMENT A microgravity isolation mount p 161 N87-29861  PRODUCTION COSTS Space Station EVA systems trade-off model [SAE PAPER 880990] p 134 A87-38767  PROGNOZ SATELLITES The Signe II gamma-ray burst experiment aboard the Prognoz 9 satellite p 150 A87-38443  PROGRAM VERIFICATION (COMPUTERS) Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  PROGRAMMING LANGUAGES KSC Space Station Operations Language (SSOL) p 138 N87-29168  PROJECT MANAGEMENT The Space Station - Work Package 3 p 118 A87-32529  USA-Europe coordination and cooperation activities: Announcements of Opportunity polar platforms p 170 N87-20632 The Columbus program p 157 N87-25031  PROJECT PLANNING Space station experiment definition: Long-term cryogenic fluid storage	Thermal design of a large spacecraft propulsion system  [AIAA PAPER 87-1863] p 44 A87-45258  Space station propulsion system technology  [NASA-TM-100108] p 97 N87-25422  Propulsion recommendations for space station free flying platforms p 98 N87-26129  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE87-010060] p 99 N87-28405  PROPULSION SYSTEM PERFORMANCE  Advanced propulsion activities in the USA p 90 A87-41575  NERVA derived nuclear orbit transfer system  [AIAA PAPER 87-2155] p 92 A87-45439  Propulsion recommendations for space station free flying platforms p 98 N87-26129  A 25-LBF gaseous oxygen/gaseous hydrogen thruster for space station application p 98 N87-26132  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE87-010060] p 99 N87-28405  PROPULSIVE EFFICIENCY  Nuclear reactor power for an electrically powered orbital transfer vehicle  [AIAA PAPER 87-1102] p 76 A87-41145  Density uncertainty effect on cost of space station reboost p 170 N87-20667  PROTECTIVE CLOTHING  Space suit extravehicular hazards protection development  [NASA-TM-89355] p 53 N87-27407  PROTECTIVE COATINGS  Selected materials issues associated with Space
reaction products with unsaturated organic molecules p 108 N87-26182  Potential surfaces for O atom-polymer reactions p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PORTABLE LIFE SUPPORT SYSTEMS  Regenerable non-venting thermal control subsystem for extravehicular activity  [SAE PAPER 860947] p 42 A87-38734  Evaluation of regenerative portable life support system options  [SAE PAPER 860948] p 49 A87-38735  POSITIVE FEEDBACK  Robust multivariable control of large space structures using positivity p 59 A87-47810  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937  POSTLAUNCH REPORTS  SPOT solar array in-orbit deployment results evaluation p 83 N87-28986  POTABLE WATER  Development of a water recovery subsystem based on Vapor Phase Catalytic Ammonia Removal (VPCAR)  [SAE PAPER 860985] p 50 A87-38764  Quality requirements for reclaimed/recycled water  [NASA-TM-58279]  POWER CONDITIONING  New power processor interfaces MMS power module outputs — Multimission Modular Spacecraft  p 77 A87-48264  Control considerations for high frequency, resonant, power processing equipment used in large systems  [NASA-TM-8926] p 68 N87-23690	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY) Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583  PRODUCT DEVELOPMENT A microgravity isolation mount p 161 N87-29861  PRODUCTION COSTS Space Station EVA systems trade-off model [SAE PAPER 860990] p 134 A87-38767  PROGNOZ SATELLITES The Signe II gamma-ray burst experiment aboard the Prognoz 9 satellite p 150 A87-38443  PROGRAM VERIFICATION (COMPUTERS) Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  PROGRAMMING LANGUAGES KSC Space Station Operations Language (SSOL) p 138 N87-29168  PROJECT MANAGEMENT The Space Station - Work Package 3 p 118 A87-32529  USA-Europe coordination and cooperation activities: Announcements of Opportunity polar platforms p 170 N87-20632 The Columbus program p 157 N87-2632  The Columbus program p 157 N87-25031  PROJECT PLANNING Space station experiment definition: Long-term cryogenic fluid storage [NASA-CR-4072] p 97 N87-24641	Thermal design of a large spacecraft propulsion system  [AIAA PAPER 87-1863] p 44 A87-45258  Space station propulsion system technology  [NASA-TM-100108] p 97 N87-25422  Propulsion recommendations for space station free flying platforms p 98 N87-26129  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE87-010060] p 99 N87-28405  PROPULSION SYSTEM PERFORMANCE  Advanced propulsion activities in the USA p 90 A87-41575  NERVA derived nuclear orbit transfer system  [AIAA PAPER 87-2155] p 92 A87-45439  Propulsion recommendations for space station free flying platforms p 98 N87-26129  A 25-LBF gaseous oxygen/gaseous hydrogen thruster for space station application p 98 N87-26129  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE87-010060] p 99 N87-28405  PROPULSIVE EFFICIENCY  Nuclear reactor power for an electrically powered orbital transfer vehicle  [AIAA PAPER 87-1102] p 76 A87-41145  Density uncertainty effect on cost of space station reboost p 170 N87-20667  PROTECTIVE CLOTHING  Space suit extravehicular hazards protection development  [NASA-TM-89355] p 53 N87-27407  PROTECTIVE COATINGS  Selected materials issues associated with Space Station p 105 A87-32061
reaction products with unsaturated organic molecules p 108 N87-26182  Potential surfaces for O atom-polymer reactions p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PORTABLE LIFE SUPPORT SYSTEMS  Regenerable non-venting thermal control subsystem for extravehicular activity  [SAE PAPER 860947] p 42 A87-38734  Evaluation of regenerative portable life support system options  [SAE PAPER 860948] p 49 A87-38735  POSITIVE FEEDBACK  Robust multivariable control of large space structures using positivity p 59 A87-47810  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937  POSITIAUNCH REPORTS  SPOT solar array in-orbit deployment results evaluation p 83 N87-28986  POTABLE WATER  Development of a water recovery subsystem based on Vapor Phase Catalytic Ammonia Removal (VPCAR)  [SAE PAPER 860985] p 50 A87-38764  Quality requirements for reclaimed/recycled water  [NASA-TM-58279] p 53 N87-27392  POWER CONDITIONING  New power processor interfaces MMS power module outputs Multimission Modular Spacecraft  p 77 A87-48264  Control considerations for high frequency, resonant, power processing equipment used in large systems  [NASA-TM-89926] p 68 N87-23690  POWER CONVERTERS  Space Station 20-kHz power management and distribution system p 75 A87-36913	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY) Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583  PRODUCT DEVELOPMENT A microgravity isolation mount p 161 N87-29861  PRODUCTION COSTS Space Station EVA systems trade-off model [SAE PAPER 880990] p 134 A87-38767  PROGNOZ SATELLITES The Signe II gamma-ray burst experiment aboard the Prognoz 9 satellite p 150 A87-38443  PROGRAM VERIFICATION (COMPUTERS) Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  PROGRAMMING LANGUAGES KSC Space Station Operations Language (SSOL) p 138 N87-29168  PROJECT MANAGEMENT The Space Station - Work Package 3 p 118 A87-32529  USA-Europe coordination and cooperation activities: Announcements of Opportunity polar platforms p 170 N87-20632 The Columbus program p 157 N87-25031  PROJECT PLANNING Space station experiment definition: Long-term cryogenic fluid storage	Thermal design of a large spacecraft propulsion system  [AIAA PAPER 87-1863] p. 44 A87-45258  Space station propulsion system technology  [NASA-TM-100108] p. 97 N87-25422  Propulsion recommendations for space station free flying platforms p. 98 N87-26129  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE67-010060] p. 99 N87-28405  PROPULSION SYSTEM PERFORMANCE  Advanced propulsion activities in the USA p. 90 A87-41575  NERVA derived nuclear orbit transfer system  [AIAA PAPER 87-2155] p. 92 A87-45439  Propulsion recommendations for space station free flying platforms p. 98 N87-26129  A 25-LBF gaseous oxygen/gaseous hydrogen thruster for space station application  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE87-010060] p. 99 N87-28405  PROPULSIVE EFFICIENCY  Nuclear reactor power for an electrically powered orbital transfer vehicle  [AIAA PAPER 87-1102] p. 76 A87-41145  Density uncertainty effect on cost of space station reboost p. 170 N87-20667  PROTECTIVE CLOTHING  Space suit extravehicular hazards protection development  [NASA-TM-89355] p. 53 N87-27407  PROTECTIVE COATINGS  Selected materials issues associated with Space station p. 105 A87-32061  Oxidation protection coatings for polymers
reaction products with unsaturated organic molecules p 108 N87-26182  Potential surfaces for O atom-polymer reactions p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PORTABLE LIFE SUPPORT SYSTEMS  Regenerable non-venting thermal control subsystem for extravehicular activity  [SAE PAPER 860947] p 42 A87-38734  Evaluation of regenerative portable life support system options  [SAE PAPER 860948] p 49 A87-38735  POSITIVE FEEDBACK  Robust multivariable control of large space structures using positivity p 59 A87-47810  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937  POSTLAUNCH REPORTS  SPOT solar array in-orbit deployment results evaluation p 83 N87-28986  POTABLE WATER  Development of a water recovery subsystem based on Vapor Phase Catalytic Ammonia Removal (VPCAR)  [SAE PAPER 860985] p 50 A87-38764  Quality requirements for reclaimed/recycled water (NASA-TM-58279)  POWER CONDITIONING  New power processor interfaces MMS power module outputs — Multimission Modular Spacecraft p 77 A87-48264  Control considerations for high frequency, resonant, power processing equipment used in large systems (NASA-TM-89926) p 68 N87-23690  POWER CONVERTERS  Space Station 20-kHz power management and distribution system p 75 A87-36913  Status of series-resonant power conversion with high	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY) Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A67-48583  PRODUCT DEVELOPMENT A microgravity isolation mount p 161 N87-29861  PRODUCTION COSTS Space Station EVA systems trade-off model [SAE PAPER 860990] p 134 A87-38767  PROGNOZ SATELLITES The Signe II gamma-ray burst experiment aboard the Prognoz 9 satellite p 150 A87-38443  PROGRAM VERIFICATION (COMPUTERS) Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  PROGRAMMING LANGUAGES KSC Space Station Operations Language (SSOL) p 138 N87-29168  PROJECT MANAGEMENT The Space Station - Work Package 3  PI18 A87-32529  USA-Europe coordination and cooperation activities: Announcements of Opportunity polar platforms p 170 N87-2632  The Columbus program p 157 N87-2632  The Columbus program p 157 N87-2631  PROJECT PLANNING Space station experiment definition: Long-term cryogenic fluid storage [NASA-CR-4072] p 97 N87-24641  Planning for future operational sensors and other priorities [NOAA-NESDIS-30]	Thermal design of a large spacecraft propulsion system  [AIAA PAPER 87-1863] p 44 A87-45258  Space station propulsion system technology  [NASA-TM-100108] p 97 N87-25422  Propulsion recommendations for space station free flying platforms p 98 N87-26129  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE87-010060] p 99 N87-28405  PROPULSION SYSTEM PERFORMANCE  Advanced propulsion activities in the USA p 90 A87-45159  NERVA derived nuclear orbit transfer system  [AIAA PAPER 87-2155] p 92 A87-45439  Propulsion recommendations for space station free flying platforms p 98 N87-26129  A 25-LBF gaseous oxygen/gaseous hydrogen thruster for space station application p 98 N87-26132  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE87-010060] p 99 N87-28405  PROPULSIVE EFFICIENCY  Nuclear reactor power for an electrically powered orbital transfer vehicle  [AIAA PAPER 87-1102] p 76 A87-41145  Density uncertainty effect on cost of space station reboost p 170 N87-20667  PROTECTIVE CLOTHING  Space suit extravehicular hazards protection development  [NASA-TM-89355] p 53 N87-27407  PROTECTIVE COATINGS  Selected materials issues associated with Space Station p 105 A87-32061
reaction products with unsaturated organic molecules p 108 N87-26182 Potential surfaces for O atom-polymer reactions p 109 N87-26201 Comments on the interaction of materials with atomic oxygen p 110 N87-26206 PORTABLE LIFE SUPPORT SYSTEMS Regenerable non-venting thermal control subsystem for extravehicular activity [SAE PAPER 860947] p 42 A87-38734 Evaluation of regenerative portable life support system options [SAE PAPER 860948] POSITIVE FEEDBACK Robust multivariable control of large space structures using positivity p 59 A87-47810 An experimental investigation of vibration suppression in large space structures using positive position feedback pOSTLAUNCH REPORTS SPOT solar array in-orbit deployment results evaluation POTABLE WATER Development of a water recovery subsystem based on Vapor Phase Catalytic Ammonia Removal (VPCAR) [SAE PAPER 860985] POTABLE WATER Development of a water recovery subsystem based on Vapor Phase Catalytic Ammonia Removal (VPCAR) [SAE PAPER 860985] Quality requirements for reclaimed/recycled water [NASA-TM-58279] POWER CONDITIONING New power processor interfaces MMS power module outputs Multimission Modular Spacecraft p 77 A67-48264 Control considerations for high frequency, resonant, power processing equipment used in large systems [NASA-TM-89926] POWER CONVERTERS Space Station 20-kHz power management and distribution system Status of series-resonant power conversion with high internal frequencies. Support in definition of space station	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY) Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583  PRODUCT DEVELOPMENT A microgravity isolation mount p 161 N87-29861  PRODUCTION COSTS Space Station EVA systems trade-off model [SAE PAPER 860990] p 134 A87-38767  PROGNOZ SATELLITES The Signe II gamma-ray burst experiment aboard the Prognoz 9 satellite p 150 A87-38443  PROGRAM VERIFICATION (COMPUTERS) Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  PROGRAMMING LANGUAGES KSC Space Station Operations Language (SSOL) p 138 N87-29168  PROJECT MANAGEMENT The Space Station - Work Package 3 p 118 A87-32529  USA-Europe coordination and cooperation activities: Announcements of Opportunity polar platforms p 170 N87-20632 The Columbus program p 157 N87-25031  PROJECT PLANNING Space station experiment definition: Long-term cryogenic fluid storage [NASA-CR-4072] p 97 N87-24641  Planning for future operational sensors and other priorities (NOAA-NESDIS-30) PROJECTILES	Thermal design of a large spacecraft propulsion system  [AIAA PAPER 87-1863] p. 44 A87-45258  Space station propulsion system technology  [NASA-TM-100108] p. 97 N87-25422  Propulsion recommendations for space station free flying platforms p. 98 N87-26129  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE67-010060] p. 99 N87-28405  PROPULSION SYSTEM PERFORMANCE  Advanced propulsion activities in the USA p. 90 A87-41575  NERVA derived nuclear orbit transfer system  [AIAA PAPER 87-2155] p. 92 A87-45439  Propulsion recommendations for space station free flying platforms p. 98 N87-26129  A 25-LBF gaseous oxygen/gaseous hydrogen thruster for space station application p. 98 N87-26132  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE67-010060] p. 99 N87-28405  PROPULSIVE EFFICIENCY  Nuclear reactor power for an electrically powered orbital transfer vehicle  [AIAA PAPER 87-1102] p. 76 A87-41145  Density uncertainty effect on cost of space station reboost p. 170 N87-20667  PROTECTIVE CLOTHING  Space suit extravehicular hazards protection development  [NASA-TM-89355] p. 53 N87-27407  PROTECTIVE COATINGS  Selected materials issues associated with Space station p. 105 A87-32061  Oxidation protection coatings for polymers  [NASA-CASE-LEW-14072-3] p. 107 N87-23736  An electrically conductive thermal control surface for spacecarát encountering Low-Earth Orbit (LEO) atomic
reaction products with unsaturated organic molecules p 108 N87-26182  Potential surfaces for O atom-polymer reactions p 109 N87-26201  Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PORTABLE LIFE SUPPORT SYSTEMS  Regenerable non-venting thermal control subsystem for extravehicular activity  [SAE PAPER 860947] p 42 A87-38734  Evaluation of regenerative portable life support system options  [SAE PAPER 860948] p 49 A87-38735  POSITIVE FEEDBACK  Robust multivariable control of large space structures using positivity p 59 A87-47810  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937  POSTLAUNCH REPORTS  SPOT solar array in-orbit deployment results evaluation p 83 N87-28986  POTABLE WATER  Development of a water recovery subsystem based on Vapor Phase Catalytic Ammonia Removal (VPCAR)  [SAE PAPER 860985] p 50 A87-38764  Quality requirements for reclaimed/recycled water (NASA-TM-58279)  POWER CONDITIONING  New power processor interfaces MMS power module outputs — Multimission Modular Spacecraft p 77 A87-48264  Control considerations for high frequency, resonant, power processing equipment used in large systems (NASA-TM-89926) p 68 N87-23690  POWER CONVERTERS  Space Station 20-kHz power management and distribution system p 75 A87-36913  Status of series-resonant power conversion with high	Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Large space structures testing [NASA-TM-100306] p 35 N87-24520  PROCESS CONTROL (INDUSTRY) Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A67-48583  PRODUCT DEVELOPMENT A microgravity isolation mount p 161 N87-29861  PRODUCTION COSTS Space Station EVA systems trade-off model [SAE PAPER 860990] p 134 A87-38767  PROGNOZ SATELLITES The Signe II gamma-ray burst experiment aboard the Prognoz 9 satellite p 150 A87-38443  PROGRAM VERIFICATION (COMPUTERS) Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  PROGRAMMING LANGUAGES KSC Space Station Operations Language (SSOL) p 138 N87-29168  PROJECT MANAGEMENT The Space Station - Work Package 3  PI18 A87-32529  USA-Europe coordination and cooperation activities: Announcements of Opportunity polar platforms p 170 N87-2632  The Columbus program p 157 N87-2632  The Columbus program p 157 N87-2631  PROJECT PLANNING Space station experiment definition: Long-term cryogenic fluid storage [NASA-CR-4072] p 97 N87-24641  Planning for future operational sensors and other priorities [NOAA-NESDIS-30]	Thermal design of a large spacecraft propulsion system  [AIAA PAPER 87-1863] p 44 A87-45258  Space station propulsion system technology  [NASA-TM-100108] p 97 N87-25422  Propulsion recommendations for space station free flying platforms p 98 N87-26129  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE87-010060] p 99 N87-28405  PROPULSION SYSTEM PERFORMANCE  Advanced propulsion activities in the USA p 90 A87-41575  NERVA derived nuclear orbit transfer system  [AIAA PAPER 87-2155] p 92 A87-45439  Propulsion recommendations for space station free flying platforms p 98 N87-26129  A 25-LBF gaseous oxygen/gaseous hydrogen thruster for space station application p 98 N87-26129  Nuclear propulsion systems for orbit transfer based on the particle bed reactor  [DE87-010060] p 99 N87-28405  PROPULSIVE EFFICIENCY  Nuclear practor power for an electrically powered orbital transfer vehicle  [AIAA PAPER 87-1102] p 76 A87-41145  Density uncertainty effect on cost of space station reboost p 170 N87-20667  PROTECTIVE CLOTHING  Space suit extravehicular hazards protection development  [NASA-TM-89355] p 53 N87-27407  PROTECTIVE COATINGS  Selected materials issues associated with Space Station Oxidation protection coatings for polymers  [NASA-CASE-LEW-14072-3] p 107 N87-23736  An electrically conductive thermal control surface for

NASA Marshall Space Flight Center atomic oxygen	n	Potential energy surfaces for atomic oxygen reactions:
investigations p 109 N87-26202		Formation of singlet and triplet biradicals as primary
An evaluation of candidate oxidation resistant	RADAR Flight array processor p 116 N87-29148	reaction products with unsaturated organic molecules
materials p 110 N87-26203	, ng.,, a., a, p	p 108 N87-26182
Surface modification to minimise the electrostatic	RADAR ANTENNAS  Nuclear reactor power for a space-based radar. SP-100	REACTION WHEELS
charging of Kapton in the space environment p 87 N87-26959	project	Control of flexible solar arrays with consideration of the
PROTOCOL (COMPUTERS)	[NASA-TM-89295] p 79 N87-25838	actuator dynamics of the reaction wheel
Star topology spacecraft data bus	RADARSAT	p 55 A87-32448
p 112 A87-37431	The Radarsat Modular Opto-electronic Multispectral	Vibration isolation for line of sight performance
Advanced local area network concepts	Scanner (R-MOMS): A potential candidate for the Polar	improvement p 67 N87-22742
p 117 N87-29153	Orbiting Platform (POP) also	REAL TIME OPERATION  On the performance analysis of a real-time distributed
PROTOTYPES	[MBB-UR-873/86] p 130 N87-25506	computer system p 111 A87-31518
Preliminary analysis of a prototype space solar power	RADIATION DAMAGE	Real-time simulation for Space Station
system	Design study of large area 8 cm x 8 cm wrapthrough	p 7 A87-37298
[ILR-MITT-168] p 79 N87-24532	cells for space station p 80 N87-26424	Video image processing p 116 N87-29150
User interface and payload command and control p 73 N87-29162	RADIATION DOSAGE Radiation dose prediction for Space Station	RECOMBINATION REACTIONS
•	[SAE PAPER 860924] p 139 A87-38715	Structure-property relationships in polymer resistance
PROVING  Panel report on new approaches to calibration and	Radiation environments and absorbed dose estimations	to atomic oxygen p 106 A87-38642
validation Columbus polar platforms	on manned space missions p 139 A87-49026	RECTANGULAR PANELS
p 157 N87-20638	RADIATION EFFECTS	Substructure analysis using NICE/SPAR and
PROVISIONING	The role of electronic mechanisms in surface erosion	applications of force to linear and nonlinear structures
Space Station Food System	and glow phenomena p 137 N87-26181	spacecraft masts [NASA-CR-180317] p 38 N87-27260
[SAE PAPER 860930] p 48 A87-38720	Space stable thermal control coatings	RECYCLING
PSYCHOLOGICAL EFFECTS	[AD-A182796] p 110 N87-28584	Gas and water recycling system for IOC vivarium
Soviet space stations as analogs, second edition	RADIATION HAZARDS	experiments Initial Operational Capacity
[NASA-CR-180920] p 157 N87-21996	The problem of radiation exposure in the Space	p 46 A87-32457
PSYCHOLOGICAL FACTORS	Station [DGLR PAPER 86-175] p 153 A87-48157	Water recycling system using thermopervaporation
The undersea habitat as a space station analog: Evaluation of research and training potential	Radiation shielding requirements on long-duration space	method p 46 A87-32458
[NASA-CR-180342] p 53 N87-27405	missions	Quality requirements for reclaimed/recycled water
PULSARS	[AD-A177512] p 140 N87-21991	[NASA-TM-58279] p 53 N87-27392
High energy gamma ray astronomy	RADIATION PRESSURE	REDUCED GRAVITY
p 129 N87-24258	Dynamic and thermal effects in very large space	On the payload-tether technology providing the microgravity circumstances in the proximity of the Space
PULSE COMMUNICATION	structures p 25 N87-20347	Station p 122 A87-32533
Multiple Access Ku-band communications subsystem for	RADIATION PROTECTION	Symposium on Microgravity Fluid Mechanics,
the Space Station p 84 A87-31462	Radiation protection problems for the Space Station and	Proceedings of the Winter Annual Meeting, Anaheim, CA,
The effect of multipath on digital communications	approaches to their mitigation p 154 A87-49030	Dec. 7-12, 1986 p 89 A87-38785
systems: With application to space station	The Aerospace Environment at High Altitudes and its Implications for Spacecraft Charging and	Non-intrusive techniques for thermal measurements in
[AD-A178578] p 86 N87-22876	Implications for Spacecraft Charging and Communications	microgravity fluid science experiments
PULSED RADIATION  Production of pulsed atomic oxygen beams via laser	[AGARD-CP-406] p 142 N87-26937	p 151 A87-39836
vaporization methods p 109 N87-26190	RADIATION SOURCES	Liquid droplet radiator development status waste heat
PULSES	Evaluation of the infrared test method for the Olympus	rejection devices for future space vehicles [AIAA PAPER 87-1537] p 43 A87-43059
Comparison of wave-mode coordinate and pulse	thermal balance tests p 44 A87-46682	[AIAA PAPER 87-1537] p 43 A87-43059 Columbus pressurized modules p 153 A87-46945
summation methods	RADIATIVE HEAT TRANSFER	Microgravity experiments onboard Eureca
[AD-A177795] p 30 N87-21992	Radiation heat transfer calculations for space	p 155 A87-53554
[AB3(11)100]		
PURIFICATION	structures	
PURIFICATION  Quality requirements for reclaimed/recycled water	[AIAA PAPER 87-1522] p 44 A87-44830	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306
PURIFICATION	[AIAA PAPER 87-1522] p 44 A87-44830 RADICALS	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status
PURIFICATION  Quality requirements for reclaimed/recycled water	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS  Potential energy surfaces for atomic oxygen reactions:	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353
PURIFICATION  Quality requirements for reclaimed/recycled water  [NASA-TM-58279] p 53 N87-27392	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS  Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary	Gas tungsten arc welding in a microgravity environment:  Work done on GAS payload G-169 p 136 N87-20306  Liquid droplet radiator development status  [NASA-TM-89852] p 44 N87-20353  Initial investigations into the damping characteristics of
PURIFICATION  Quality requirements for reclaimed/recycled water	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS  Potential energy surfaces for atomic oxygen reactions:	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators
PURIFICATION  Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS  Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY	Gas tungsten arc welding in a microgravity environment:  Work done on GAS payload G-169 p 136 N87-20306  Liquid droplet radiator development status  [NASA-TM-89852] p 44 N87-20353  Initial investigations into the damping characteristics of wire rope vibration isolators  [NASA-CR-180698] p 28 N87-20569
PURIFICATION Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  Q QUALIFICATIONS	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS  Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY  Status of orbital astronomy projects	Gas tungsten arc welding in a microgravity environment:  Work done on GAS payload G-169 p 136 N87-20306  Liquid droplet radiator development status  [NASA-TM-89852] p 44 N87-20353  Initial investigations into the damping characteristics of wire rope vibration isolators  [NASA-CR-180698] p 28 N87-20569  The coupled dynamics of fluids and spacecraft in low
PURIFICATION Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  Q  QUALIFICATIONS Mechanical Qualification of Large Flexible Spacecraft Structures	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS  Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY  Status of orbital astronomy projects p 128 N87-21973	Gas tungsten arc welding in a microgravity environment:  Work done on GAS payload G-169 p 136 N87-20306  Liquid droplet radiator development status  [NASA-TM-89852] p 44 N87-20353  Initial investigations into the damping characteristics of wire rope vibration isolators  [NASA-CR-180698] p 28 N87-20569  The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement
PURIFICATION Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  Q QUALIFICATIONS	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS  Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY  Status of orbital astronomy projects p 128 N87-21973  RADIO BEACONS	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement p 94 N87-21147
PURIFICATION Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  Q  QUALIFICATIONS Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529] p 26 N87-20355 Future trends in spacecraft design and qualification	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS  Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY Status of orbital astronomy projects p 128 N87-21973  RADIO BEACONS Design of a beacon receiving system for the Olympus	Gas tungsten arc welding in a microgravity environment:  Work done on GAS payload G-169 p 136 N87-20306  Liquid droplet radiator development status  [NASA-TM-89852] p 44 N87-20353  Initial investigations into the damping characteristics of wire rope vibration isolators  [NASA-CR-180698] p 28 N87-20569  The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement  P 94 N87-21147  Numerical modelling of cryogenic propellant behavior in low-G
PURIFICATION Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  Q  QUALIFICATIONS Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529] p 26 N87-20355 Future trends in spacecraft design and qualification p 2 N87-20356	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS  Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY  Status of orbital astronomy projects  p 128 N87-21973  RADIO BEACONS  Design of a beacon receiving system for the Olympus satellite p 86 A87-50157	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement p 94 N87-21147 Numerical modelling of cryogenic propellant behavior iow-G in low-G in two-phase thermal
QUALIFICATIONS Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529] Future trends in spacecraft design and qualification of Page 187-20356 Recent developments and future trends in structural	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS  Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY  Status of orbital astronomy projects p 128 N87-21973  RADIO BEACONS  Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY	Gas tungsten arc welding in a microgravity environment:  Work done on GAS payload G-169 p 136 N87-20306  Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353  Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569  The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement  Numerical modelling of cryogenic propellant behavior in low-G p 95 N87-21148  Microgravity fluid management in two-phase thermal p 95 N87-21152
QUALIFICATION Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  QUALIFICATIONS Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529] p 26 N87-20355 Future trends in spacecraft design and qualification p 2 N87-20356 Recent developments and future trends in structural dynamic design verification and qualification of large	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS  Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY  Status of orbital astronomy projects p 128 N87-21973  RADIO BEACONS  Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY  Radiation environments and absorbed dose estimations	Gas tungsten arc welding in a microgravity environment:  Work done on GAS payload G-169 p 136 N87-20306  Liquid droplet radiator development status  [NASA-TM-89852] p 44 N87-20353  Initial investigations into the damping characteristics of wire rope vibration isolators  [NASA-CR-180698] p 28 N87-20569  The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement  Numerical modelling of cryogenic propellant behavior in low-G p 95 N87-21148  Microgravity fluid management in two-phase thermal systems  Microgravity fluid management of requirements of
PURIFICATION Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  QUALIFICATIONS  Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529] p 26 N87-20355 Future trends in spacecraft design and qualification p 2 N87-20356 Recent developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft p 156 N87-20357	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS  Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules  p 108 N87-26182  RADIO ASTRONOMY  Status of orbital astronomy projects  p 128 N87-21973  RADIO BEACONS  Design of a beacon receiving system for the Olympus satellite  p 86 A87-50157  RADIOBIOLOGY  Radiation environments and absorbed dose estimations on manned space missions  p 139 A87-49026  Radiation protection problems for the Space Station and	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement p 94 N87-21147 Numerical modelling of cryogenic propellant behavior in low-G Microgravity fluid management in two-phase thermal systems p 5 N87-21152 Microgravity fluid management requirements of advanced solar dynamic power systems
Qualification Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  Q QUALIFICATIONS Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529] p 26 N87-20355 Future trends in spacecraft design and qualification p 2 N87-20356 Recent developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft Qualification of the faint object camera	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS  Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY  Status of orbital astronomy projects p 128 N87-21973  RADIO BEACONS  Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY  Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement Numerical modelling of cryogenic propellant behavior in low-G p 95 N87-21147 Microgravity fluid management in two-phase thermal p 95 N87-21152 Microgravity fluid management requirements of advanced solar dynamic power systems p 77 N87-21153
QUALIFICATION Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  QUALIFICATIONS Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529] p 26 N87-20355 Future trends in spacecraft design and qualification p 2 N87-20356 Recent developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft p 156 N87-20357 Qualification of the faint object camera p 127 N87-20359	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS  Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY Status of orbital astronomy projects p 128 N87-21973  RADIO BEACONS Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  RANDOM VIBRATION	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement Numerical modelling of cryogenic population behavior in low-G p 95 N87-21147 Microgravity fluid management in two-phase thermal p 95 N87-21152 Microgravity fluid management requirements of advanced solar dynamic power systems p 77 N87-21153 Two-phase reduced gravity experiments for a space
QUALIFICATION Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  QUALIFICATIONS Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529] p 26 N87-20355 Future trends in spacecraft design and qualification p 2 N87-20356 Recent developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft Qualification of the faint object camera p 127 N87-20359 Dynamic analysis of direct television satellite	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS  Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY  Status of orbital astronomy projects p 128 N87-21973  RADIO BEACONS  Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY  Radiation environments and absorbed dose estimations on manned space missions on manned space missions RANDOM VIBRATION  Prediction of random vibrational responses of a large	Gas tungsten arc welding in a microgravity environment:  Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement Numerical modelling of cryogenic propellant behavior in low-G p 95 N87-21147 Microgravity fluid management in two-phase thermal systems p 77 N87-21152 Microgravity fluid management requirements of advanced solar dynamic power systems p 77 N87-21153 Two-phase reduced gravity experiments for a space p 8 N87-21154 Structural/control interaction (payload pointing and
QUALIFICATION Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  QUALIFICATIONS Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529] p 26 N87-20355 Future trends in spacecraft design and qualification p 2 N87-20356 Recent developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft p 156 N87-20357 Qualification of the faint object camera p 127 N87-20359 Dynamic analysis of direct television satellite TV-SAT/TDF.1	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS  Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY  Status of orbital astronomy projects p 128 N87-21973  RADIO BEACONS  Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY  Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  RANDOM VIBRATION  Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method	Gas tungsten arc welding in a microgravity environment:  Work done on GAS payload G-169 p 136 N87-20306  Liquid droplet radiator development status  [NASA-TM-89852] p 44 N87-20353  Initial investigations into the damping characteristics of wire rope vibration isolators  [NASA-CR-180698] p 28 N87-20569  The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement  Numerical modelling of cryogenic propellant behavior in low-G p 95 N87-21148  Microgravity fluid management in two-phase thermal systems p 5 N87-21152  Microgravity fluid management requirements of advanced solar dynamic power systems p 77 N87-21153  Two-phase reduced gravity experiments for a space reactor design p 8 N87-21154  Structural/control interaction (payload pointing and p 9 N87-22721
QUALIFICATION Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  QUALIFICATIONS Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529] p 26 N87-20355 Future trends in spacecraft design and qualification p 2 N87-20356 Recent developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft p 156 N87-20357 Qualification of the faint object camera p 127 N87-20359 Dynamic analysis of direct television satellite TV-SAT/TDF.1 p 86 N87-20360 Structural qualification of large spacecraft	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS  Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules  p 108 N87-26182  RADIO ASTRONOMY  Status of orbital astronomy projects  p 128 N87-21973  RADIO BEACONS  Design of a beacon receiving system for the Olympus satellite  p 86 A87-50157  RADIOBIOLOGY  Radiation environments and absorbed dose estimations on manned space missions  p 139 A87-49026  Radiation protection problems for the Space Station and approaches to their mitigation  p 154 A87-49030  RANDOM VIBRATION  Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method  p 144 A87-32334	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement p 94 N87-21147 Numerical modelling of cryogenic propellant behavior in low-G Microgravity fluid management in two-phase thermal systems p 95 N87-21148 Microgravity fluid management requirements of advanced solar dynamic power systems p 77 N87-21153 Two-phase reduced gravity experiments for a space reactor design p 8 N87-21154 Structural/control interaction (payload pointing and micro-g) Ideas for educational physics experiments in space
QUALIFICATION Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  QUALIFICATIONS Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529] p 26 N87-20355 Future trends in spacecraft design and qualification p 2 N87-20356 Recent developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft p 156 N87-20357 Qualification of the faint object camera p 127 N87-20359 Dynamic analysis of direct television satellite TV-SAT/TDF-1 p 86 N87-20360 Structural qualification of large spacecraft p 26 N87-20361	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS  Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY  Status of orbital astronomy projects  P 128 N87-21973  RADIO BEACONS  Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY  Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  RANDOM VIBRATION  Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334  Optimization of aerospace structures subjected to	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement Numerical modelling of cryogenic propellant behavior in low-G Microgravity fluid management in two-phase thermal systems p 95 N87-21148 Microgravity fluid management requirements of advanced solar dynamic power systems p 77 N87-21153 Two-phase reduced gravity experiments for a space reactor design p 8 N87-21154 Structural/control interaction (payload pointing and p 9 N87-22721 ldeas for educational physics experiments in space p 130 N87-25033
QUALIFICATION Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  QUALIFICATIONS Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529] p 26 N87-20355 Future trends in spacecraft design and qualification p 2 N87-20356 Recent developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft p 156 N87-20357 Qualification of the faint object camera p 127 N87-20359 Dynamic analysis of direct television satellite TV-SAT/TDF.1 p 86 N87-20360 Structural qualification of large spacecraft p 26 N87-20361 Dynamic qualification of spacecraft by means of modal	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS  Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules  p 108 N87-26182  RADIO ASTRONOMY  Status of orbital astronomy projects  p 128 N87-21973  RADIO BEACONS  Design of a beacon receiving system for the Olympus satellite  p 86 A87-50157  RADIOBIOLOGY  Radiation environments and absorbed dose estimations on manned space missions  p 139 A87-49026  Radiation protection problems for the Space Station and approaches to their mitigation  p 154 A87-49030  RANDOM VIBRATION  Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method  p 144 A87-32334	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement Numerical modelling of cryogenic propellant behavior in low-G p 95 N87-21147 Microgravity fluid management in two-phase thermal systems p 77 N87-21152 Microgravity fluid management requirements of advanced solar dynamic power systems p 77 N87-21153 Two-phase reduced gravity experiments for a space reactor design p 8 N87-21154 Structural/control interaction (payload pointing and micro-g) p 130 N87-25033 Active vibration control in microgravity environment
QUALIFICATIONS  A Mechanical Qualification of Large Flexible Spacecraft Structures  [AD-A175529]  P 26 N87-20355  Future trends in spacecraft design and qualification of large flexible spacecraft design and qualification of large flexible spacecraft design and qualification of large flexible spacecraft of the property of the propert	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY Status of orbital astronomy projects P 128 N87-21973  RADIO BEACONS Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  RANDOM VIBRATION Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334 Optimization of aerospace structures subjected to random vibration and fatigue constraints p 29 N87-20599	Gas tungsten arc welding in a microgravity environment:  Work done on GAS payload G-169 p 136 N87-20306  Liquid droplet radiator development status  [NASA-TM-89852] p 44 N87-20353  Initial investigations into the damping characteristics of wire rope vibration isolators  [NASA-CR-180698] p 28 N87-20569  The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement p 94 N87-21147  Numerical modelling of cryogenic propellant behavior in low-G p 95 N87-21148  Microgravity fluid management in two-phase thermal p 95 N87-21152  Microgravity fluid management advanced solar dynamic power systems p 77 N87-21153  Two-phase reduced gravity experiments for a space reactor design p 8 N87-2154  Structural/control interaction (payload pointing and p 9 N87-22721 Ideas for educational physics experiments in space p 130 N87-25033  Active vibration control in microgravity environment p 72 N87-26700
QUALIFICATION Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  QUALIFICATIONS Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529] p 26 N87-20355 Future trends in spacecraft design and qualification p 2 N87-20356 Recent developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft p 156 N87-20357 Qualification of the faint object camera p 127 N87-20359 Dynamic analysis of direct television satellite TV-SAT/TDF.1 p 86 N87-20360 Structural qualification of large spacecraft p 26 N87-20361 Dynamic qualification of spacecraft by means of modal synthesis Low frequency vibration testing on satellites	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS  Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY  Status of orbital astronomy projects p 128 N87-21973  RADIO BEACONS  Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY  Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  RANDOM VIBRATION  Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334  Optimization of aerospace structures subjected to random vibration and fatigue constraints p 29 N87-20599  RANKINE CYCLE  Organic Rankine cycle power conversion systems for	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement p 94 N87-21147 Numerical modelling of cryogenic propellant behavior in low-G p 95 N87-21148 Microgravity fluid management in two-phase thermal systems p 95 N87-21152 Microgravity fluid management requirements of advanced solar dynamic power systems p 77 N87-21153 Two-phase reduced gravity experiments for a space p 8 N87-21154 Structural/control interaction (payload pointing and micro-g) lideas for educational physics experiments in space p 130 N87-25033 Active vibration control in microgravity environment p 72 N87-26700 The evolution of a serviceable EURECA
QUALIFICATION Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  QUALIFICATIONS Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529] p 26 N87-20355 Future trends in spacecraft design and qualification p 2 N87-20356 Recent developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft p 156 N87-20357 Qualification of the faint object camera p 127 N87-20359 Dynamic analysis of direct television satellite TV-SAT/TDE-1 p 86 N87-20360 Structural qualification of large spacecraft p 26 N87-20361 Dynamic qualification of spacecraft by means of modal synthesis p 26 N87-20363 Low frequency vibration testing on satellities p 27 N87-20364	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS  Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY  Status of orbital astronomy projects p 128 N87-21973  RADIO BEACONS  Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY  Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  RANDOM VIBRATION  Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334  Optimization of aerospace structures subjected to random vibration and fatigue constraints p 29 N87-20599  RANKINE CYCLE  Organic Rankine cycle power conversion systems for space applications	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement p 94 N87-21147 Numerical modelling of cryogenic propellant behavior in low-G Microgravity fluid management in two-phase thermal systems p 95 N87-21152 Microgravity fluid management requirements of advanced solar dynamic power systems p 77 N87-21153 Two-phase reduced gravity experiments for a space reactor design p 8 N87-21154 Structural/control interaction (payload pointing and micro-g) ldeas for educational physics experiments in space p 130 N87-25033 Active vibration control in microgravity environment p 72 N87-26700 The evolution of a serviceable EURECA [MBB-UR-E-923/86] p 121 N87-26841
QUALIFICATION Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  QUALIFICATIONS Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529] p 26 N87-20355 Future trends in spacecraft design and qualification p 2 N87-20356 Recent developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft p 156 N87-20357 Qualification of the faint object camera p 127 N87-20357 Qualification of the faint object camera p 127 N87-20360 Structural qualification of large spacecraft p 26 N87-20361 Dynamic qualification of spacecraft by means of modal synthesis p 26 N87-20363 Low frequency vibration testing on satellites p 27 N87-20364 Modal-survey testing for system identification and	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY Status of orbital astronomy projects P 128 N87-21973  RADIO BEACONS Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  RANDOM VIBRATION Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334 Optimization of aerospace structures subjected to random vibration and fatigue constraints p 29 N87-20599  RANKINE CYCLE Organic Rankine cycle power conversion systems for space applications	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement Numerical modelling of cryogenic popellant behavior in low-G p 94 N87-21147 Microgravity fluid management in two-phase thermal systems Microgravity fluid management in two-phase thermal p 95 N87-21152 Microgravity fluid management requirements of advanced solar dynamic power systems  p 77 N87-21153 Two-phase reduced gravity experiments for a space reactor design p 8 N87-21154 Structural/control interaction (payload pointing and micro-g) p 9 N87-22721 Ideas for educational physics experiments in space p 130 N87-25033 Active vibration control in microgravity environment p 72 N87-26700 The evolution of a serviceable EURECA [MBB-UR-E-923/86] p 121 N87-26841 A microgravity isolation mount p 161 N87-29861
QUALIFICATION Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  QUALIFICATIONS Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529] p 26 N87-20355 Future trends in spacecraft design and qualification p 2 N87-20356 Recent developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft p 156 N87-20357 Qualification of the faint object camera p 127 N87-20359 Dynamic analysis of direct television satellite TV-SAT/TDE-1 p 86 N87-20360 Structural qualification of large spacecraft p 26 N87-20361 Dynamic qualification of spacecraft by means of modal synthesis p 26 N87-20363 Low frequency vibration testing on satellities p 27 N87-20364	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY Status of orbital astronomy projects p 128 N87-21973  RADIO BEACONS Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY Radiation environments and absorbed dose estimations on manned space missions on manned space missions RANOM VIBRATION Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334 Optimization of aerospace structures subjected to random vibration and fatigue constraints p 29 N87-20599  RANKINE CYCLE Organic Rankine cycle power conversion systems for space applications High power/large area PV systems	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement p 94 N87-21147 Numerical modelling of cryogenic propellant behavior in low-G p 95 N87-21148 Microgravity fluid management in two-phase thermal systems p 95 N87-21152 Microgravity fluid management in advanced solar dynamic power systems p 77 N87-21153 Two-phase reduced gravity experiments for a space reactor design p 8 N87-21154 Structural/control interaction (payload pointing and micro-g) Ideas for educational physics experiments in space p 130 N87-22721 Ideas for educational physics experiments in space p 130 N87-25033 Active vibration control in microgravity environment p 72 N87-26700 The evolution of a serviceable EURECA [MBB-UR-E-923/86] p 121 N87-26841 REDUCED ORDER FILTERS
QUALIFICATION Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  QUALIFICATIONS Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529] p 26 N87-20355 Future trends in spacecraft design and qualification p 2 N87-20356 Recent developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft p 156 N87-20357 Qualification of the faint object camera p 127 N87-20357 Qualification of the faint object camera p 127 N87-20359 Dynamic analysis of direct television satellite TV-SAT/TDF.1 p 86 N87-20360 Structural qualification of large spacecraft p 26 N87-20361 Dynamic qualification of spacecraft by means of modal synthesis p 26 N87-20363 Low frequency vibration testing on satellites p 27 N87-20364 Modal-survey testing for system identification and dynamic qualification of spacecraft structures p 27 N87-20365	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY Status of orbital astronomy projects p 128 N87-21973  RADIO BEACONS Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  RANDOM VIBRATION Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334  Optimization of aerospace structures subjected to random vibration and fatigue constraints p 29 N87-20599  RANKINE CYCLE Organic Rankine cycle power conversion systems for space applications p 159 N87-28989  RANKING High power/large area PV systems	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement p 94 N87-21147 Numerical modelling of cryogenic propellant behavior in low-G p 95 N87-21148 Microgravity fluid management in two-phase thermal systems p 95 N87-21152 Microgravity fluid management requirements of advanced solar dynamic power systems p 77 N87-21153 Two-phase reduced gravity experiments for a space reactor design p 8 N87-21154 Structural/control interaction (payload pointing and micro-g) ldeas for educational physics experiments in space p 130 N87-22721 Ideas for educational physics experiments in space p 130 N87-25033 Active vibration control in microgravity environment p 72 N87-26700 The evolution of a serviceable EURECA [MBB-UR-E-923/86] p 121 N87-26841 A microgravity isolation mount p 161 N87-29861 REDUCED ORDER FILTERS Reduced-order compensation - LQG reduction versus
QUALIFICATION Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  QUALIFICATIONS Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529] p 26 N87-20355 Future trends in spacecraft design and qualification p 2 N87-20356 Recent developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft p 156 N87-20357 Qualification of the faint object camera p 127 N87-20357 Qualification of the faint object camera p 127 N87-20359 Dynamic analysis of direct television satellite TV-SAT/TDF.1 p 86 N87-20360 Structural qualification of large spacecraft p 26 N87-20361 Dynamic qualification of spacecraft by means of modal synthesis p 26 N87-20363 Low frequency vibration testing on satellites p 27 N87-20364 Modal-survey testing for system identification and dynamic qualification of spacecraft structures p 27 N87-20365	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY Status of orbital astronomy projects P 128 N87-21973  RADIO BEACONS Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  RANDOM VIBRATION Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334 Optimization of aerospace structures subjected to random vibration and fatigue constraints p 29 N87-20599  RANKINE CYCLE Organic Rankine cycle power conversion systems for space applications p 159 N87-28989  RANKING High power/large area PV systems P 80 N87-26452	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement p 94 N87-21147 Numerical modelling of cryogenic propellant behavior in low-G p 95 N87-21148 Microgravity fluid management in two-phase thermal systems p 95 N87-21152 Microgravity fluid management requirements of advanced solar dynamic power systems p 77 N87-21153 Two-phase reduced gravity experiments for a space reactor design p 8 N87-2154 Structural/control interaction (payload pointing and micro-g) p 9 N87-22721 Ideas for educational physics experiments in space p 130 N87-25033 Active vibration control in microgravity environment p 72 N87-26700 The evolution of a serviceable EURECA [MBB-UR-E-923/86] p 121 N87-26841 A microgravity isolation mount p 161 N87-29861 REDUCED ORDER FILTERS Reduced-order compensation - LOG reduction versus optimal projection
Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  QUALIFICATIONS  Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529] p 26 N87-20355  Future trends in spacecraft design and qualification p 2 N87-20356  Recent developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft p 156 N87-20357  Qualification of the faint object camera p 127 N87-20359  Dynamic analysis of direct television satellite TV-SAT/TDF.1 p 86 N87-20360  Structural qualification of large spacecraft p 26 N87-20361  Dynamic qualification of spacecraft by means of modal synthesis p 27 N87-20363  Low frequency vibration testing on satellites p 27 N87-20364  Modal-survey testing for system identification and dynamic qualification of spacecraft structures p 27 N87-20365  QUALITY CONTROL  Quality monitoring in two-phase heat transport systems for large spacecraft	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY Status of orbital astronomy projects p 128 N87-21973  RADIO BEACONS Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  RANDOM VIBRATION Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334  Optimization of aerospace structures subjected to random vibration and fatigue constraints p 29 N87-20599  RANKINE CYCLE Organic Rankine cycle power conversion systems for space applications p 159 N87-28989  RANKING High power/large area PV systems	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement  Numerical modelling of cryogenic propellant behavior in low-G p 95 N87-21147 Microgravity fluid management in two-phase thermal systems Microgravity fluid management requirements of advanced solar dynamic power systems  p 77 N87-21153 Two-phase reduced gravity experiments for a space reactor design p 8 N87-21154 Structural/control interaction (payload pointing and micro-g) ldeas for educational physics experiments in space p 130 N87-25033 Active vibration control in microgravity environment p 72 N87-26700 The evolution of a serviceable EURECA [MBB-UR-E-923/86] p 121 N87-26841 A microgravity isolation mount p 161 N87-29861  REDUCED ORDER FILTERS Reduced-order compensation - LOG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-5042
QUALIFICATION Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  QUALIFICATIONS Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529] p 26 N87-20355 Future trends in spacecraft design and qualification p 2 N87-20356 Recent developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft p 156 N87-20357 Qualification of the faint object camera p 127 N87-20359 Dynamic analysis of direct television satellite TV-SAT/TDF-1 p 86 N87-20360 Structural qualification of large spacecraft p 26 N87-20361 Dynamic qualification of spacecraft by means of modal synthesis p 26 N87-20363 Low frequency vibration testing on satellites p 27 N87-20364 Modal-survey testing for system identification and dynamic qualification of spacecraft structures p 27 N87-20365  QUALITY CONTROL Quality monitoring in two-phase heat transport systems for large spacecraft [SAE PAPER 860959] p 42 A87-38743	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY Status of orbital astronomy projects P 128 N87-21973  RADIO BEACONS Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  RANDOM VIBRATION Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334 Optimization of aerospace structures subjected to random vibration and fatigue constraints p 29 N87-20599  RANKINE CYCLE Organic Rankine cycle power conversion systems for space applications p 159 N87-28989  RANKING High power/large area PV systems P 80 N87-26452  RAYLEIGH-RITZ METHOD Localization of vibrations in large space reflectors [AIAA PAPER 87-0949] p 18 A87-33745	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement p 94 N87-21147 Numerical modelling of cryogenic propellant behavior in low-G Microgravity fluid management in two-phase thermal systems p 95 N87-21148 Microgravity fluid management requirements of advanced solar dynamic power systems p 77 N87-21153 Two-phase reduced gravity experiments for a space reactor design p 8 N87-21154 Structural/control interaction (payload pointing and micro-g) ldeas for educational physics experiments in space p 130 N87-25033 Active vibration control in microgravity environment p 72 N87-26700 The evolution of a serviceable EURECA [MBB-UR-E-923/86] p 121 N87-26841 A microgravity isolation mount p 161 N87-29861 REDUCETION (CHEMISTRY)
QUALIFICATION Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  QUALIFICATIONS Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529] p 26 N87-20355 Future trends in spacecraft design and qualification p 2 N87-20356 Recent developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft p 156 N87-20357 Qualification of the faint object camera p 127 N87-20359 Dynamic analysis of direct television satellite TV-SAT/TDE-1 p 86 N87-20360 Structural qualification of large spacecraft p 26 N87-20361 Dynamic qualification of spacecraft by means of modal synthesis p 26 N87-20363 Low frequency vibration testing on satellities p 27 N87-20364 Modal-survey testing for system identification and dynamic qualification of spacecraft structures p 27 N87-20365  QUALITY CONTROL Quality monitoring in two-phase heat transport systems for large spacecraft [SAE PAPER 860959] p 42 A87-38743 EMC and power quality standards for 20-kHz power	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY Status of orbital astronomy projects p 128 N87-21973  RADIO BEACONS Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  RANDOM VIBRATION Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334 Optimization of aerospace structures subjected to random vibration and fatigue constraints p 29 N87-20599  RANKINE CYCLE Organic Rankine cycle power conversion systems for space applications p 159 N87-28989  RANKING High power/large area PV systems  p 80 N87-26452  RAYLEIGH-RITZ METHOD Localization of vibrations in large space reflectors [AIAA PAPER 87-0949] p 18 A87-33745  REACTION KINETICS  Material interactions with the Low Earth Orbital (LEO)	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement p 94 N87-21147 Numerical modelling of cryogenic propellant behavior in low-G Microgravity fluid management in two-phase thermal systems p 95 N87-21148 Microgravity fluid management requirements of advanced solar dynamic power systems p 77 N87-21153 Two-phase reduced gravity experiments for a space reactor design p 8 N87-21154 Structural/control interaction (payload pointing and micro-g) ldeas for educational physics experiments in space p 130 N87-25033 Active vibration control in microgravity environment p 72 N87-26700 The evolution of a serviceable EURECA [MBB-UR-E-923/86] p 121 N87-26841 A microgravity isolation mount p 161 N87-29861 REDUCED ORDER FILTERS Reduced-order compensation - LOG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 REDUCTION (CHEMISTRY) An advanced carbon reactor subsystem for carbon
QUALIFICATION Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  QUALIFICATIONS Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529] p 26 N87-20355 Future trends in spacecraft design and qualification p 2 N87-20356 Recent developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft p 156 N87-20357 Qualification of the faint object camera p 127 N87-20359 Dynamic analysis of direct television satellite TV-SAT/TDF.1 p 86 N87-20360 Structural qualification of large spacecraft p 26 N87-20361 Dynamic qualification of large spacecraft p 26 N87-20363 Low frequency vibration testing on satellites p 27 N87-20364 Modal-survey testing for system identification and dynamic qualification of spacecraft structures p 27 N87-20365 QUALITY CONTROL Quality monitoring in two-phase heat transport systems for large spacecraft [SAE PAPER 860959] p 42 A87-38743 EMC and power quality standards for 20-kHz power distribution	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY Status of orbital astronomy projects p 128 N87-21973  RADIO BEACONS Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  RANDOM VIBRATION Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334 Optimization of aerospace structures subjected to random vibration and fatigue constraints  p 29 N87-20599  RANKINE CYCLE Organic Rankine cycle power conversion systems for space applications p 159 N87-28989  RANKING High power/large area PV systems  p 80 N87-26452  RAYLEIGH-RITZ METHOD Localization of vibrations in large space reflectors [AIAA PAPER 87-0949] p 18 A87-33745  REACTION KINETICS Material interactions with the Low Earth Orbital (LEO) environment: Accurate reaction rate measurements	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement  P 94 N87-21147 Numerical modelling of cryogenic propellant behavior in low-G p 95 N87-21145 Microgravity fluid management in two-phase thermal systems p 95 N87-21152 Microgravity fluid management requirements of advanced solar dynamic power systems  P 77 N87-21153 Two-phase reduced gravity experiments for a space reactor design p 8 N87-21154 Structural/control interaction (payload pointing and micro-g) p 9 N87-22721 Ideas for educational physics experiments in space p 130 N87-25033 Active vibration control in microgravity environment p 72 N87-26700 The evolution of a serviceable EURECA [MBB-UR-E-923/86] p 121 N87-26841 A microgravity isolation mount p 161 N87-29861  REDUCED ORDER FILTERS Reduced-order compensation - LOG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472  REDUCTION (CHEMISTRY) An advanced carbon reactor subsystem for carbon dioxide reduction
QUALIFICATION Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  QUALIFICATIONS Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529] p 26 N87-20355 Future trends in spacecraft design and qualification p 2 N87-20356 Recent developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft p 156 N87-20357 Qualification of the faint object camera p 127 N87-20359 Dynamic analysis of direct television satellite TV-SAT/TDF.1 p 86 N87-20360 Structural qualification of large spacecraft p 26 N87-20361 Dynamic qualification of spacecraft by means of modal synthesis p 26 N87-20363 Low frequency vibration testing on satellites p 27 N87-20364 Modal-survey testing for system identification and dynamic qualification of spacecraft structures p 27 N87-20365  QUALITY CONTROL Quality monitoring in two-phase heat transport systems for large spacecraft [SAE PAPER 860959] p 42 A87-38743 EMC and power quality standards for 20-kHz power distribution [NASA-TM-89925] p 78 N87-22004	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY Status of orbital astronomy projects P 128 N87-21973  RADIO BEACONS Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  RANDOM VIBRATION Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334 Optimization of aerospace structures subjected to random vibration and fatigue constraints p 29 N87-20599  RANKINE CYCLE Organic Rankine cycle power conversion systems for space applications p 159 N87-28989  RANKING High power/large area PV systems P 80 N87-26452  RAYLEIGH-RITZ METHOD Localization of vibrations in large space reflectors [AIAA PAPER 87-0949] p 18 A87-33745  REACTION KINETICS Material interactions with the Low Earth Orbital (LEO) environment: Accurate reaction rate measurements	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement p 94 N87-21147 Numerical modelling of cryogenic propellant behavior in low-G p 95 N87-21148 Microgravity fluid management in two-phase thermal systems p 95 N87-21148 Microgravity fluid management in advanced solar dynamic power systems p 77 N87-21153 Two-phase reduced gravity experiments for a space reactor design p 8 N87-21154 Structural/control interaction (payload pointing and micro-g) Ideas for educational physics experiments in space p 130 N87-22721 Ideas for educational physics experiments in space p 130 N87-25033 Active vibration control in microgravity environment p 72 N87-26700 The evolution of a serviceable EURECA [MBB-UR-E-923/86] p 121 N87-26841 A microgravity isolation mount p 161 N87-29861  REDUCED ORDER FILTERS Reduced-order compensation - LOG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472  REDUCTION (CHEMISTRY) An advanced carbon reactor subsystem for carbon dioxide reduction [SAE PAPER 860995] p 51 A87-38772
QUALIFICATION Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  QUALIFICATIONS Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529] p 26 N87-20355 Future trends in spacecraft design and qualification p 2 N87-20356 Recent developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft p 156 N87-20357 Qualification of the faint object camera p 127 N87-20359 Dynamic analysis of direct television satellite TV-SAT/TDF.1 p 86 N87-20360 Structural qualification of large spacecraft p 26 N87-20360 Structural qualification of spacecraft by means of modal synthesis p 26 N87-20363 Low frequency vibration testing on satellites p 27 N87-20363 Modal-survey testing for system identification and dynamic qualification of spacecraft structures p 27 N87-20365  QUALITY CONTROL Quality monitoring in two-phase heat transport systems for large spacecraft [SAE PAPER 860959] p 42 A87-38743 EMC and power quality standards for 20-kHz power distribution [NASA-TM-89925] p 78 N87-22004	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY Status of orbital astronomy projects P 128 N87-21973  RADIO BEACONS Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  RANDOM VIBRATION Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334 Optimization of aerospace structures subjected to random vibration and fatigue constraints p 29 N87-20599  RANKINE CYCLE Organic Rankine cycle power conversion systems for space applications p 159 N87-28989  RANKING High power/large area PV systems P 80 N87-26452  RAYLEIGH-RITZ METHOD Localization of vibrations in large space reflectors [AIAA PAPER 87-0949] p 18 A87-33745  REACTION KINETTICS Material interactions with the Low Earth Orbital (LEO) environment: Accurate reaction rate measurements p 108 N87-26175 Kinetics and mechanisms of some atomic oxygen	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement p 94 N87-21147 Numerical modelling of cryogenic propellant behavior in low-G Microgravity fluid management in two-phase thermal systems p 95 N87-21152 Microgravity fluid management requirements of advanced solar dynamic power systems p 77 N87-21153 Two-phase reduced gravity experiments for a space reactor design p 8 N87-21154 Structural/control interaction (payload pointing and micro-g) ldeas for educational physics experiments in space p 130 N87-25033 Active vibration control in microgravity environment p 72 N87-26700 The evolution of a serviceable EURECA [MBB-UR-E-923/86] p 121 N87-26841 A microgravity isolation mount p 161 N87-29861 REDUCED ORDER FILTERS Reduced-order compensation - LOG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 REDUCTION (CHEMISTRY) An advanced carbon reactor subsystem for carbon dioxide reduction [SAE PAPER 860995] p 51 A87-38772
Qualify requirements for reclaimed/recycled water [NASA-TM-58279]  QUALIFICATIONS  Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529]  Future trends in spacecraft design and qualification p 2 N87-20356  Recent developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft  Qualification of the faint object camera  p 127 N87-20357  Qualification of the faint object camera  p 127 N87-20359  Dynamic analysis of direct television satellite TV-SAT/TDF.1  p 86 N87-20360  Structural qualification of large spacecraft  p 26 N87-20361  Dynamic qualification of spacecraft by means of modal synthesis  p 27 N87-20363  Low frequency vibration testing on satellites  p 27 N87-20364  Modal-survey testing for system identification and dynamic qualification of spacecraft structures  p 27 N87-20365  QUALITY CONTROL  Quality monitoring in two-phase heat transport systems for large spacecraft  [SAE PAPER 860959]  p 42 A87-38743  EMC and power quality standards for 20-kHz power distribution  [NASA-TM-89925]  QUANTUM CHEMISTRY  Potential energy surfaces for atomic oxygen reactions:	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY Status of orbital astronomy projects p 128 N87-21973  RADIO BEACONS Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY Radiation environments and absorbed dose estimations on manned space missions on manned space missions p 139 A87-49026 Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  RANDOM VIBRATION Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334 Optimization of aerospace structures subjected to random vibration and fatigue constraints p 29 N87-20599  RANKINE CYCLE Organic Rankine cycle power conversion systems for space applications p 159 N87-28989  RANKING High power/large area PV systems p 80 N87-26452  RAYLEIGH-RITZ METHOD Localization of vibrations in large space reflectors [AIAA PAPER 87-0949] p 18 A87-33745  REACTION KINETICS Material interactions with the Low Earth Orbital (LEC) environment: Accurate reaction rate measurements p 108 N87-26175 Kinetics and mechanisms of some atomic oxygen reactions p 141 N87-26179	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement p 94 N87-21147 Numerical modelling of cryogenic propellant behavior in low-G p 95 N87-21148 Microgravity fluid management in two-phase thermal systems p 95 N87-21148 Microgravity fluid management in advanced solar dynamic power systems p 77 N87-21153 Two-phase reduced gravity experiments for a space reactor design p 8 N87-21154 Structural/control interaction (payload pointing and micro-g) Ideas for educational physics experiments in space p 130 N87-22721 Ideas for educational physics experiments in space p 130 N87-25033 Active vibration control in microgravity environment p 72 N87-26700 The evolution of a serviceable EURECA [MBB-UR-E-923/86] p 121 N87-26841 A microgravity isolation mount p 161 N87-29861  REDUCED ORDER FILTERS Reduced-order compensation - LOG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472  REDUCTION (CHEMISTRY) An advanced carbon reactor subsystem for carbon dioxide reduction [SAE PAPER 860995] p 51 A87-38772
QUALIFICATIONS  Mechanical Qualification of Large Flexible Spacecraft Structures  [AD-A175529]  P 26 N87-20355  Future trends in spacecraft design and qualification of Large flexible spacecraft developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft p 156 N87-20357  Qualification of the faint object camera  P 127 N87-20359  Dynamic analysis of direct television satellite TV-SAT/TDF.1  Structural qualification of large spacecraft  Dynamic qualification of spacecraft by means of modal synthesis  Low frequency vibration testing on satellites  P 27 N87-20363  Low frequency vibration testing on satellites  P 27 N87-20364  Modal-survey testing for system identification and dynamic qualification of spacecraft structures  P 27 N87-20365  QUALITY CONTROL  Quality monitoring in two-phase heat transport systems for large spacecraft  [SAE PAPER 860959]  P 42 A87-38743  EMC and power quality standards for 20-kHz power distribution  [NASA-TM-89925]  P 78 N87-22004  QUANTUM CHEMISTRY  Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY Status of orbital astronomy projects  P 128 N87-21973  RADIO BEACONS Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  RANDOM VIBRATION Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334  Optimization of aerospace structures subjected to random vibration and fatigue constraints p 29 N87-20599  RANKINE CYCLE Organic Rankine cycle power conversion systems for space applications p 159 N87-28989  RANKING High power/large area PV systems  P 80 N87-26452  RAYLEIGH-RITZ METHOD Localization of vibrations in large space reflectors [AIAA PAPER 87-0949] p 18 A87-33745  REACTION KINETICS Material interactions with the Low Earth Orbital (LEO) environment: Accurate reaction rate measurements p 108 N87-26179 Product energy distributions and energy partitioning in	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement p 94 N87-21147 Numerical modelling of cryogenic propellant behavior in low-G Microgravity fluid management in two-phase thermal systems p 95 N87-21148 Microgravity fluid management in two-phase thermal systems p 77 N87-21153 Two-phase reduced gravity experiments for a space reactor design p 8 N87-21154 Structural/control interaction (payload pointing and micro-g) ldeas for educational physics experiments in space p 130 N87-22721 Ideas for educational physics experiments in space p 130 N87-25033 Active vibration control in microgravity environment p 72 N87-26700 The evolution of a serviceable EURECA [MBB-UR-E-923/86] p 121 N87-26841 A microgravity isolation mount p 161 N87-29861 REDUCED ORDER FILTERS Reduced-order compensation - LOG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 REDUCTION (CHEMISTRY) An advanced carbon reactor subsystem for carbon dioxide reduction [SAE PAPER 860995] p 51 A87-38772 REENTRY EFFECTS Effect of long-term exposure to LEO space environment on spacecraft materials p 106 A87-39426
QUALIFICATIONS  Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529]  Future trends in spacecraft design and qualification of Large flexible spacecraft p 156 N87-20356  Recent developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft p 156 N87-20357  Qualification of the faint object camera p 127 N87-20359  Dynamic analysis of direct television satellite TV-SAT/TDF.1 p 86 N87-20360  Structural qualification of large spacecraft p 26 N87-20361  Dynamic qualification of spacecraft by means of modal synthesis p 26 N87-20363  Low frequency vibration testing on satellites p 27 N87-20364  Modal-survey testing for system identification and dynamic qualification of spacecraft structures p 27 N87-20365  QUALITY CONTROL  Quality monitoring in two-phase heat transport systems for large spacecraft  [SAE PAPER 860959] p 42 A87-38743  EMC and power quality standards for 20-kHz power distribution  [NASA-TM-89925] p 78 N87-22004  QUANTUM CHEMISTRY  Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY Status of orbital astronomy projects Pablo BEACONS Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  RANDOM VIBRATION Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-3234 Optimization of aerospace structures subjected to random vibration and fatigue constraints p 29 N87-20599  RANKINE CYCLE Organic Rankine cycle power conversion systems for space applications p 159 N87-28989  RANKING High power/large area PV systems  P 80 N87-26452  RAYLEIGH-RITZ METHOD Localization of vibrations in large space reflectors [AIAA PAPER 87-0949] p 18 A87-33745  REACTION KINETICS Material interactions with the Low Earth Orbital (LEO) environment: Accurate reaction rate measurements p 108 N87-26175 Kinetics and mechanisms of some atomic oxygen reactions p 141 N87-26179 Product energy distributions and energy partitioning in O atom reactions on surfaces p 108 N87-26180	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement
Qualify requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  QUALIFICATIONS  Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529] p 26 N87-20355  Future trends in spacecraft design and qualification p 2 N87-20356  Recent developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft p 156 N87-20357  Qualification of the faint object camera p 127 N87-20359  Dynamic analysis of direct television satellite TV-SAT/TDF.1 p 86 N87-20360  Structural qualification of large spacecraft p 26 N87-20361  Dynamic qualification of spacecraft by means of modal synthesis p 27 N87-20363  Low frequency vibration testing on satellites p 27 N87-20364  Modal-survey testing for system identification and dynamic qualification of spacecraft structures p 27 N87-20365  QUALITY CONTROL  Qualify monitoring in two-phase heat transport systems for large spacecraft [SAE PAPER 860959] p 42 A87-38743  EMC and power quality standards for 20-kHz power distribution [NASA-TM-89925] p 78 N87-22004  QUANTUM CHEMISTRY  Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY Status of orbital astronomy projects p 128 N87-21973  RADIO BEACONS Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  RANDOM VIBRATION Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334 Optimization of aerospace structures subjected to random vibration and fatigue constraints p 29 N87-20599  RANKINE CYCLE Organic Rankine cycle power conversion systems for space applications p 159 N87-28989  RANKING High power/large area PV systems  P 80 N87-26452  RAYLEIGH-RITZ METHOD Localization of vibrations in large space reflectors [AIAA PAPER 87-0949] p 18 A87-33745  REACTION KINETICS Material interactions with the Low Earth Orbital (LEC) environment: Accurate reaction rate measurements p 108 N87-26179 Product energy distributions and energy partitioning in O atom reactions on surfaces p 108 N87-26180 Potential energy surfaces for atomic oxygen reactions	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement
QUALIFICATIONS  Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529]  Future trends in spacecraft design and qualification of Large flexible spacecraft p 156 N87-20356  Recent developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft p 156 N87-20357  Qualification of the faint object camera p 127 N87-20359  Dynamic analysis of direct television satellite TV-SAT/TDF.1 p 86 N87-20360  Structural qualification of large spacecraft p 26 N87-20361  Dynamic qualification of spacecraft by means of modal synthesis p 26 N87-20363  Low frequency vibration testing on satellites p 27 N87-20364  Modal-survey testing for system identification and dynamic qualification of spacecraft structures p 27 N87-20365  QUALITY CONTROL  Quality monitoring in two-phase heat transport systems for large spacecraft  [SAE PAPER 860959] p 42 A87-38743  EMC and power quality standards for 20-kHz power distribution  [NASA-TM-89925] p 78 N87-22004  QUANTUM CHEMISTRY  Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY Status of orbital astronomy projects P 128 N87-21973  RADIO BEACONS Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  RANDOM VIBRATION Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334 Optimization of aerospace structures subjected to random vibration and fatigue constraints p 29 N87-20599  RANKINE CYCLE Organic Rankine cycle power conversion systems for space applications p 159 N87-28989  RANKING High power/large area PV systems  RAYLEIGH-RITZ METHOD Localization of vibrations in large space reflectors [AIAA PAPER 87-0949] p 18 A87-33745  REACTION KINETICS Material interactions with the Low Earth Orbital (LEO) environment: Accurate reaction rate measurements P 108 N87-26175  Kinetics and mechanisms of some atomic oxygen reactions P 104 N87-26179 Product energy distributions and energy partitioning in O atom reactions on surfaces p 108 N87-26180 Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement p 94 N87-21147 Numerical modelling of cryogenic propellant behavior in low-G p 95 N87-21148 Microgravity fluid management in two-phase thermal systems p 95 N87-21148 Microgravity fluid management requirements of advanced solar dynamic power systems p 77 N87-21153 Two-phase reduced gravity experiments for a space reactor design p 8 N87-21154 Structural/control interaction (payload pointing and micro-g) ldeas for educational physics experiments in space p 130 N87-25033 Active vibration control in microgravity environment p 72 N87-26841 A microgravity isolation mount p 161 N87-26841 A microgravity isolation mount p 161 N87-29861 REDUCED ORDER FILTERS Reduced-order compensation - LQG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 REDUCTION (CHEMISTRY) An advanced carbon reactor subsystem for carbon dioxide reduction [SAE PAPER 860995] p 51 A87-38772 REENTRY EFFECTS Effect of long-term exposure to LEO space environment on spacecraft materials p 106 A87-39426 REENTRY PHYSICS Nonequilibrium radiation during re-entry at 10 km/s [AIAA PAPER 87-1543] p 135 A87-43060
QUALIFICATIONS  Mechanical Qualification of Large Flexible Spacecraft Structures  [AD-A175529]  P 26 N87-20355  Future trends in spacecraft design and qualification of Large flexible spacecraft developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft p 156 N87-20357  Qualification of the faint object camera  P 127 N87-20359  Dynamic analysis of direct television satellite TV-SAT/TDF.1  P 86 N87-20360  Structural qualification of large spacecraft p 26 N87-20361  Dynamic qualification of spacecraft by means of modal synthesis  Low frequency vibration testing on satellites  P 27 N87-20363  Low frequency vibration testing on satellites  P 27 N87-20363  COMALITY CONTROL  Quality monitoring in two-phase heat transport systems for large spacecraft  [SAE PAPER 860959]  P 42 A87-38743  EMC and power quality standards for 20-kHz power distribution  [NASA-TM-89925]  P 78 N87-22004  QUANTUM CHEMISTRY  Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules  P 108 N87-26182  Potential surfaces for O atom-polymer reactions  P 109 N87-26201	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY Status of orbital astronomy projects P 128 N87-21973  RADIO BEACONS Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  RANDOM VIBRATION Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334  Optimization of aerospace structures subjected to random vibration and fatigue constraints p 29 N87-20599  RANKINE CYCLE Organic Rankine cycle power conversion systems for space applications p 159 N87-28989  RANKING High power/large area PV systems  P 80 N87-26452  RAYLEIGH-RITZ METHOD Localization of vibrations in large space reflectors [AIAA PAPER 87-0949] p 18 A87-33745  REACTION KINETICS Material interactions with the Low Earth Orbital (LEO) environment: Accurate reaction rate measurements p 108 N87-26175  Kinetics and mechanisms of some atomic oxygen reactions Product energy distributions and energy partitioning in O atom reactions on surfaces p 108 N87-26180 Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement p 94 N87-21147 Numerical modelling of cryogenic propellant behavior in low-G Microgravity fluid management in two-phase thermal systems p 95 N87-21148 Microgravity fluid management requirements of advanced solar dynamic power systems p 77 N87-21153 Two-phase reduced gravity experiments for a space reactor design p 8 N87-21154 Structural/control interaction (payload pointing and micro-g) ldeas for educational physics experiments in space p 130 N87-25033 Active vibration control in microgravity environment p 72 N87-26700 The evolution of a serviceable EURECA [MBB-UR-E-923/86] p 121 N87-26841 A microgravity isolation mount p 161 N87-29861 REDUCED ORDER FILTERS Reduced-order compensation - LOG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 REDUCTION (CHEMISTRY) An advanced carbon reactor subsystem for carbon dioxide reduction [SAE PAPER 860995] p 51 A87-38772 REENTRY EFFECTS Effect of long-term exposure to LEO space environment on spacecraft materials p 106 A87-39426 REENTRY PHYSICS Nonequilibrium radiation during re-entry at 10 km/s [AIAA PAPER 87-1543] p 135 A87-43060 REFERENCE SYSTEMS Plasma motor/generator reference system designs for
QUALIFICATION Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392  QUALIFICATIONS Mechanical Qualification of Large Flexible Spacecraft Structures [AD-A175529] p 26 N87-20355 Future trends in spacecraft design and qualification p 2 N87-20356 Recent developments and future trends in structural dynamic design verification and qualification of large flexible spacecraft p 156 N87-20357 Qualification of the faint object camera p 127 N87-20359 Dynamic analysis of direct television satellite TV-SAT/TDF.1 p 86 N87-20360 Structural qualification of large spacecraft p 26 N87-20361 Dynamic qualification of large spacecraft by means of modal synthesis p 27 N87-20363 Low frequency vibration testing on satellites p 27 N87-20364 Modal-survey testing for system identification and dynamic qualification of spacecraft structures p 27 N87-20365  QUALITY CONTROL Quality monitoring in two-phase heat transport systems for large spacecraft [SAE PAPER 860959] p 42 A87-38743 EMC and power quality standards for 20-kHz power distribution [NASA-TM-89925] p 78 N87-22004  QUANTUM CHEMISTRY Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182 Potential surfaces for O atom-polymer reactions	[AIAA PAPER 87-1522] p 44 A87-44830  RADICALS Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules p 108 N87-26182  RADIO ASTRONOMY Status of orbital astronomy projects  Paper 128 N87-21973  RADIO BEACONS Design of a beacon receiving system for the Olympus satellite p 86 A87-50157  RADIOBIOLOGY Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  RANDOM VIBRATION Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334  Optimization of aerospace structures subjected to random vibration and fatigue constraints p 29 N87-20599  RANKINE CYCLE Organic Rankine cycle power conversion systems for space applications p 159 N87-28989  RANKING High power/large area PV systems  P 80 N87-26452  RAYLEIGH-RITZ METHOD Localization of vibrations in large space reflectors [AIAA PAPER 87-0949] p 18 A87-33745  REACTION KINETICS Material interactions with the Low Earth Orbital (LEO) environment: Accurate reaction rate measurements p 108 N87-26175  Kinetics and mechanisms of some atomic oxygen reactions P 108 N87-26175  Kinetics and mechanisms of some atomic oxygen reactions O atom reactions on surfaces p 108 N87-26180 Potential energy surfaces for atomic oxygen reactions: Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement p 94 N87-21147 Numerical modelling of cryogenic propellant behavior in low-G p 95 N87-21148 Microgravity fluid management in two-phase thermal systems p 95 N87-21148 Microgravity fluid management requirements of advanced solar dynamic power systems p 77 N87-21153 Two-phase reduced gravity experiments for a space reactor design p 8 N87-21154 Structural/control interaction (payload pointing and micro-g) ldeas for educational physics experiments in space p 130 N87-25033 Active vibration control in microgravity environment p 72 N87-26841 A microgravity isolation mount p 161 N87-26841 A microgravity isolation mount p 161 N87-29861 REDUCED ORDER FILTERS Reduced-order compensation - LQG reduction versus optimal projection [AIAA PAPER 87-2388] p 61 A87-50472 REDUCTION (CHEMISTRY) An advanced carbon reactor subsystem for carbon dioxide reduction [SAE PAPER 860995] p 51 A87-38772 REENTRY EFFECTS Effect of long-term exposure to LEO space environment on spacecraft materials p 106 A87-39426 REENTRY PHYSICS Nonequilibrium radiation during re-entry at 10 km/s [AIAA PAPER 87-1543] p 135 A87-43060

REFILLING		Service Manipulator Arm (SMA) for a Robotic Servicing	National Aeronautics and Space Administration
Propellant tank resupply system [AD-D012559]	p 93 N87-20375	Experiment (ROSE) [ESA-CR(P)-2347] p 103 N87-28260	Authorization Act, fiscal year 1988 [H-REPT-100-204] p 171 N87-25024
REFLECTOR ANTENNAS	•	Mobile remote manipulator vehicle system	RESEARCH FACILITIES
Thermal deformation and electric		[NASA-CASE-LAR-13393-1] p 103 N87-29118	Telerobotic technology for nuclear and space
antenna reflector with truss backstruc	nture p 12 A87-32405	The design and development of a mobile transporter system for the Space Station Remote Manipulator	applications [NASA-CR-180923] p 102 N87-22242
Integrated structural electromagnet	•	System p 104 N87-29865	RESIDUAL STRESS
large space antenna reflectors		REMOTE SENSING	Nonlinear transient analysis of joint dominated
[AIAA PAPER 87-0824]	p 14 A87-33611	Design of a polar platform with an earth observation payload p 122 A87-32538	structures [AIAA PAPER 87-0892] p 17 A87-33709
Quasi-static shape adjustment of a space antenna	15 meter diameter	The Tethered Satellite System as a new remote sensing	Evaluation of the built-in stresses and residual distortions
[AIAA PAPER 87-0869]	p 15 A87-33633	platform p 124 A87-39183	on cured composites for space antenna reflectors
Evaluation of the built-in stresses and		Space Station opportunity for UK in earth sensing p 152 A87-41678	applications p 22 A87-47327
on cured composites for space	antenna reflectors p 22 A87-47327	Remote sensing; Proceedings of the Meeting, Orlando,	RESIN MATRIX COMPOSITES PEEK (Polyether ether ketone) with 30 percent of carbon
applications  Analysis of on-orbit thermal cha	•	FL, Apr. 3, 4, 1986	fibres for injection molding p 22 A87-44588
15-meter hoop/column antenna	stacteristics of the	[SPIE-644] p 125 A87-44176 Developing Space Station. II - Power, rendezvous,	RESISTOJET ENGINES
[NASA-TM-89137]	p 45 N87-21021	docking and remote sensing are important elements of	Resistojet control and power for high frequency ac
Robust control for large space ante		the Space Station p 127 A87-54198	buses
Controlo atrivativas algoritarios estimativas	p 87 N87-24499	SAFE/DAE: Modal test in space p 77 N87-20584	[AIAA PAPER 87-0994] p 58 A87-41103 Conceptual design and integration of a Space Station
Controls-structures-electromagnetics program	s interaction p 69 N87-24502	Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for	resistojet propulsion assembly
REFLECTORS	p 00 1101 = 100=	Remote-Sensing (ESPOIR)	[AIAA PAPER 87-1860] p 91 A87-45256
Localization of vibrations in large sp		[ESA-SP-266] p 128 N87-20621	Preliminary performance characterizations of an
[AIAA PAPER 87-0949]	p 18 A87-33745	Remote sensing applications: Commercial issues and opportunities for space station SPOT	engineering model multipropellant resistojet for space station application
Composite space antenna structure environmental effects	p 20 A87-38610	p 156 N87-20626	[AIAA PAPER 87-2120] p 93 A87-50197
REFRIGERATORS	p 20 7101 00010	Land panel report International Space Station	Effect of nozzle geometry on the resistojet exhaust
Magnetic refrigeration for space plan		p 128 N87-20634	plume
[SAE PAPER 861724] REFUELING	p 118 A87-32613	Problems in merging Earth sensing satellite data sets [NASA-TM-87820] p 129 N87-22457	[AIAA PAPER 87-2121] p 62 A87-52252
Refueling satellites in space - The	e OSCBS program	Remote Sensing Information Sciences Research Group:	Conceptual design and integration of a space station resistojet propulsion assembly
[SAE PAPER 861797]	p 88 A87-32645	Santa Barbara Information Sciences Research Group, year	[NASA-TM-89847] p 93 N87-20378
Demands imposed on a surface tens		4	Resistojet control and power for high frequency ac
due to refuellability in the microgravity e space	environment of outer	[NASA-CR-181073] p 115 N87-24817 <b>REMOTE SENSORS</b>	buses
[DGLR PAPER 86-104]	p 88 A87-36756	Development of sensors for remote manipulator system	[NASA-TM-89860] p 63 N87-20477
Propellant tank resupply system	·	of Japanese Experiment Module p 147 A87-32547	A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet
[AD-D012559]	p 93 N87-20375	Payload data management scheme planned for Earth observation sensors to be flown on the polar platforms	[NASA-TM-89854] p 96 N87-22237
Quick-disconnect inflatable seal ass [NASA-CASE-KSC-11368-1]	p 102 N87-25583	in the framework of the space station/Columbus	Preliminary performance characterizations of an
A study of fluid transfer managemen		program p 114 N87-20630	engineering model multipropellant resistojet for space
[FTMS-RPT-006]	p 97 N87-26058	Planning for future operational sensors and other	station application [NASA-TM-100113] p 96 N87-23821
REGENERATIVE FUEL CELLS  Development of an alkaline fuel cell	Leubevetom	priorities [NOAA-NESDIS-30] p 130 N87-25560	Resistojet plume and induced environment analysis
[NASA-CR-172002]	p 81 N87-28188	Rendezvous and docking (RVD) long range RF sensor	[NASA-TM-88957] p 96 N87-24536
Space Electrochemical Research		definition study, executive summary	Space station propulsion system technology
(SERT)		[SES/ENG/ES-519/86] p 138 N87-28588	[NASA-TM-100108] p 97 N87-25422
[NASA-CP-2484] Advanced fuel cell concepts for futu	p 5 N87-29914	REMOTELY PILOTED VEHICLES  Use of heads-up displays, speech recognition, and	Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135
Advanced Idei Cen Concepts for Idea	p 99 N87-29930	speech synthesis in controlling a remotely piloted space	RESONANCE
Regenerative fuel cells for space ap	plications	vehicle p 99 A87-31493	Control considerations for high frequency, resonant,
RELEASING	p 84 N87-29938	RENDEZVOUS GUIDANCE Rendezvous and docking tracker	power processing equipment used in large systems
Preloadable vector sensitive latch		[AAS PAPER 86-014] p 133 A87-32733	[NASA-TM-89926] p 68 N87-23690
	p 161 N87-25582	Laser docking system flight experiment	RESONANT FREQUENCIES On the payload-tether technology providing the
RELIABILITY		[AAS PAPER 86-043] p 99 A87-32745	microgravity circumstances in the proximity of the Space
A multiple attribute decision analysis systems	s of manned airlock	Inadequacy of single-impulse transfers for path	Station p 122 A87-32533
		CONSTRAINED TENDEZVOUS D. 90 AX/-41615	•
Network reliability	p 137 N87-23682	constrained rendezvous p 90 A87-41615 REPLENISHMENT	Wave propagation in periodic truss structures
	p 137 N87-23682 p 117 N87-29157	REPLENISHMENT A quantitative comparison of several orbital maneuvering	Wave propagation in periodic truss structures [AIAA PAPER 87-0944] p 18 A87-33742
RELIABILITY ENGINEERING	p 117 N87-29157	REPLENISHMENT  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment	Wave propagation in periodic truss structures [AIAA PAPER 87-0944] p 18 A87-33742 Determination of the natural frequencies of the
Automatic generation of stochastica	p 117 N87-29157	REPLENISHMENT A quantitative comparison of several orbital maneuvering	Wave propagation in periodic truss structures [AIAA PAPER 87-0944] p 18 A87-33742
Automatic generation of stochastica modes for large-scale structures <b>REMOTE CONTROL</b>	p 117 N87-29157 illy dominant failure p 149 A87-37853	REPLENISHMENT A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677 REQUIREMENTS High power/large area PV systems	Wave propagation in periodic truss structures  [AIAA PAPER 87-0944] p 18 A87-33742  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  Flexibility effects - Estimation of the stiffness matrix in
Automatic generation of stochastica modes for large-scale structures REMOTE CONTROL Traction-drive telerobot for space m.	p 117 N87-29157 illy dominant failure p 149 A87-37853 anipulation	REPLENISHMENT A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677 REQUIREMENTS High power/large area PV systems p 80 N87-26452	Wave propagation in periodic truss structures [AIAA PAPER 87-0944] p 18 A87-33742 Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121 Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714
Automatic generation of stochastica modes for large-scale structures  REMOTE CONTROL Traction-drive telerobot for space m [DE87-005326]	p 117 N87-29157 Illy dominant failure p 149 A87-37853 ianipulation p 102 N87-22233	REPLENISHMENT A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677 REQUIREMENTS High power/large area PV systems p 80 N87-26452 Space Station end effector strategy study	Wave propagation in periodic truss structures [AIAA PAPER 87-0944] p 18 A87-33742 Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121 Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714 Commit your works to the Lord, and your thoughts shall
Automatic generation of stochastica modes for large-scale structures  REMOTE CONTROL Traction-drive telerobot for space m [DE87-005326] Telerobotic work system: Concept	p 117 N87-29157 Illy dominant failure p 149 A87-37853 ianipulation p 102 N87-22233	REPLENISHMENT A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677 REQUIREMENTS High power/large area PV systems  Space Station end effector strategy study [NASA-TM-100488] p 103 N87-29593 RESCUE OPERATIONS	Wave propagation in periodic truss structures [AIAA PAPER 87-0944] p 18 A87-33742 Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121 Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714
Automatic generation of stochastica modes for large-scale structures  REMOTE CONTROL Traction-drive telerobot for space m [DE87-005326] Telerobotic work system: Concept evolution REMOTE HANDLING	p 117 N87-29157 illy dominant failure p 149 A87-37853 anipulation p 102 N87-22233 t development and p 104 N87-29866	REPLENISHMENT  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  REQUIREMENTS  High power/large area PV systems  p 80 N87-26452  Space Station end effector strategy study [NASA-TM-100488] p 103 N87-29593  RESCUE OPERATIONS  A quantitative comparison of several orbital maneuvering	Wave propagation in periodic truss structures [AIAA PAPER 87-0944] p 18 A87-33742 Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121 Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714 Commit your works to the Lord, and your thoughts shall be established (Prov. 16:3). Inter-stable control systems p 9 N87-22716  RESONANT VIBRATION
Automatic generation of stochastica modes for large-scale structures  REMOTE CONTROL.  Traction-drive telerobot for space m [DE87-005326]  Telerobotic work system: Concept evolution (REMOTE HANDLING)  A master-slave manipulator system is concept and the control of the control	p 117 N87-29157  illy dominant failure p 149 A87-37853  ianipulation p 102 N87-22233 t development and p 104 N87-29866  for space use	REPLENISHMENT A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  REQUIREMENTS High power/large area PV systems  Space Station end effector strategy study [NASA-TM-100488] p 103 N87-26452  RESCUE OPERATIONS A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment	Wave propagation in periodic truss structures [AIAA PAPER 87-0944] p 18 A87-33742  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714  Commit your works to the Lord, and your thoughts shall be established (Prov. 16:3). Inter-stable control systems p 9 N87-22716  RESONANT VIBRATION  Determination of the natural frequencies of the
Automatic generation of stochastica modes for large-scale structures  REMOTE CONTROL.  Traction-drive telerobot for space m [DE87-005326]  Telerobotic work system: Concept evolution (REMOTE HANDLING)  A master-slave manipulator system is concept and the control of the control	p 117 N87-29157  illy dominant failure p 149 A87-37853  ianipulation p 102 N87-22233 t development and p 104 N87-29866  for space use p 147 A87-32546	REPLENISHMENT  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  REQUIREMENTS  High power/large area PV systems  p 80 N87-26452  Space Station end effector strategy study [NASA-TM-100488] p 103 N87-29593  RESCUE OPERATIONS  A quantitative comparison of several orbital maneuvering	Wave propagation in periodic truss structures [AIAA PAPER 87-0944] p 18 A87-33742  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714  Commit your works to the Lord, and your thoughts shall be established (Prov. 16:3). Inter-stable control systems p 9 N87-22716  RESONANT VIBRATION  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with
Automatic generation of stochastica modes for large-scale structures  REMOTE CONTROL Traction-drive telerobot for space m [DE87-005326] Telerobotic work system: Concept evolution REMOTE HANDLING A master-slave manipulator system of [AIAA PAPER 87-1677]	p 117 N87-29157  illy dominant failure p 149 A87-37853  ianipulation p 102 N87-22233 t development and p 104 N87-29866  for space use p 147 A87-32546	REPLENISHMENT  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment (AD-A179106) p 161 N87-23677  REQUIREMENTS  High power/large area PV systems  p 80 N87-26452  Space Station end effector strategy study [NASA-TM-100488] p 103 N87-29593  RESCUE OPERATIONS  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  RESEARCH AND DEVELOPMENT  Space research - At a crossroads	Wave propagation in periodic truss structures [AIAA PAPER 87-0944] p 18 A87-33742  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714  Commit your works to the Lord, and your thoughts shall be established (Prov. 16:3). Inter-stable control systems p 9 N87-22716  RESONANT VIBRATION  Determination of the natural frequencies of the
Automatic generation of stochastica modes for large-scale structures  REMOTE CONTROL.  Traction-drive telerobot for space m [DE87-005326] Telerobotic work system: Concept evolution  REMOTE HANDLING A master-slave manipulator system for [AIAA PAPER 87-1677]  REMOTE MANIPULATOR SYSTEM	p 117 N87-29157 illy dominant failure p 149 A87-37853 sanipulation p 102 N87-22233 t development and p 104 N87-29866 for space use p 147 A87-32546 the Space Station p 100 A87-41153	REPLENISHMENT  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  REQUIREMENTS  High power/large area PV systems  p 80 N87-26452  Space Station end effector strategy study [NASA-TM-100488] p 103 N87-29593  RESCUE OPERATIONS  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  RESEARCH AND DEVELOPMENT  Space research - At a crossroads  p 166 A87-32017	Wave propagation in periodic truss structures [AIAA PAPER 87-0944] p 18 A87-33742  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714  Commit your works to the Lord, and your thoughts shall be established (Prov. 16:3). Inter-stable control systems p 9 N87-22716  RESONANT VIBRATION  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  RETRACTABLE EQUIPMENT  EURECA application of the Retractable Advanced Rigid
Automatic generation of stochastica modes for large-scale structures  REMOTE CONTROL  Traction-drive telerobot for space m [DE87-005326]  Telerobotic work system: Concept evolution  REMOTE HANDLING  A master-slave manipulator system for [AIAA PAPER 87-1677]  REMOTE MANIPULATOR SYSTEM  Development of sensors for remote r	p 117 N87-29157 illy dominant failure p 149 A87-37853 sanipulation p 102 N87-22233 t development and p 104 N87-29866 for space use p 147 A87-32546 the Space Station p 100 A87-41153	REPLENISHMENT  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment (AD-A179106) p 161 N87-23677  REQUIREMENTS  High power/large area PV systems  p 80 N87-26452  Space Station end effector strategy study [NASA-TM-100488] p 103 N87-29593  RESCUE OPERATIONS  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  RESEARCH AND DEVELOPMENT  Space research - At a crossroads	Wave propagation in periodic truss structures  [AIAA PAPER 87-0944] p 18 A87-33742  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714  Commit your works to the Lord, and your thoughts shall be established (Prov. 16:3). Inter-stable control systems p 9 N87-22716  RESONANT VIBRATION  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  RETRACTABLE EQUIPMENT  EURECA application of the Retractable Advanced Rigid Array (RARA) solar array p 82 N87-28973
Automatic generation of stochastica modes for large-scale structures  REMOTE CONTROL.  Traction-drive telerobot for space m [DE87-005326] Telerobotic work system: Concept evolution  REMOTE HANDLING A master-slave manipulator system for [AIAA PAPER 87-1677]  REMOTE MANIPULATOR SYSTEM Development of sensors for remote r of Japanese Experiment Module Robots on the Space Station	p 117 N87-29157  Illy dominant failure p 149 A87-37853  Inipulation p 102 N87-22233 t development and p 104 N87-29866  for space use p 147 A87-32546 the Space Station p 100 A87-41153  manipulator system p 147 A87-32547 p 100 A87-40844	REPLENISHMENT  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106]  REQUIREMENTS  High power/large area PV systems  p 80 N87-26452  Space Station end effector strategy study [NASA-TM-100488] p 103 N87-29593  RESCUE OPERATIONS  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  RESEARCH AND DEVELOPMENT  Space research - At a crossroads  p 166 A87-32017  Design and development of a Space Station proximity operations research and development mockup [SAE PAPER 861785] p 133 A87-32634	Wave propagation in periodic truss structures  [AIAA PAPER 87-0944] p 18 A87-33742  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714  Commit your works to the Lord, and your thoughts shall be established (Prov. 16:3). Inter-stable control systems p 9 N87-22716  RESONANT VIBRATION  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  RETRACTABLE EQUIPMENT  EURECA application of the Retractable Advanced Rigid Array (RARA) solar array p 82 N87-28973  The extendable and retractable mast as supporting tool for rigid solar arrays p 3 N87-29012
Automatic generation of stochastica modes for large-scale structures  REMOTE CONTROL.  Traction-drive telerobot for space m [DE87-005326] Telerobotic work system: Concept evolution  REMOTE HANDLING A master-slave manipulator system for [AIAA PAPER 87-1677]  REMOTE MANIPULATOR SYSTEM Development of sensors for remote r of Japanese Experiment Module Robots on the Space Station Japanese Experiment Module (JEM)	p 117 N87-29157  Illy dominant failure p 149 A87-37853  Inipulation p 102 N87-22233 t development and p 104 N87-29866  for space use p 147 A87-32546 the Space Station p 100 A87-41153  manipulator system p 147 A87-32547 p 100 A87-40844 preliminary design	REPLENISHMENT A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677 REQUIREMENTS High power/large area PV systems  p 80 N87-26452 Space Station end effector strategy study [NASA-TM-100488] p 103 N87-29593 RESCUE OPERATIONS A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677 RESEARCH AND DEVELOPMENT Space research - At a crossroads  p 166 A87-32017 Design and development of a Space Station proximity operations research and development mockup [SAE PAPER 861785] p 133 A87-32634 K.E. Tsiolkovskii and problems in the development of	Wave propagation in periodic truss structures  [AIAA PAPER 87-0944] p 18 A87-33742  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714  Commit your works to the Lord, and your thoughts shall be established (Prov. 16:3). Inter-stable control systems p 9 N87-22716  RESONANT VIBRATION  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  RETRACTABLE EQUIPMENT  EURECA application of the Retractable Advanced Rigid Array (RARA) solar array p 82 N87-28973  The extendable and retractable mast as supporting tool for rigid solar arrays p 39 N87-29012  REUSABLE LAUNCH VEHICLES
Automatic generation of stochastica modes for large-scale structures REMOTE CONTROL.  Traction-drive telerobot for space m [DE87-005326] Telerobotic work system: Concept evolution REMOTE HANDLING A master-slave manipulator system of [AIAA PAPER 87-1677] REMOTE MANIPULATOR SYSTEM Development of sensors for remote r of Japanese Experiment Module Robots on the Space Station Japanese Experiment Module (JEM) status	p 117 N87-29157  illy dominant failure p 149 A87-37853  anipulation p 102 N87-22233 t development and p 104 N87-29866  for space use p 147 A87-32546 the Space Station p 100 A87-41153  manipulator system p 147 A87-32547 p 100 A87-40844 preliminary design p 151 A87-41570	REPLENISHMENT  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106]  REQUIREMENTS  High power/large area PV systems  p 80 N87-26452  Space Station end effector strategy study [NASA-TM-100488] p 103 N87-29593  RESCUE OPERATIONS  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  RESEARCH AND DEVELOPMENT  Space research - At a crossroads  p 166 A87-32017  Design and development of a Space Station proximity operations research and development mockup  [SAE PAPER 861785] p 133 A87-32634	Wave propagation in periodic truss structures  [AIAA PAPER 87-0944] p 18 A87-33742  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714  Commit your works to the Lord, and your thoughts shall be established (Prov. 16:3). Inter-stable control systems p 9 N87-22716  RESONANT VIBRATION  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  RETRACTABLE EQUIPMENT  EURECA application of the Retractable Advanced Rigid Array (RARA) solar array p 82 N87-28973  The extendable and retractable mast as supporting tool for rigid solar arrays p 39 N87-29012  REUSABLE LAUNCH VEHICLES  The single-stage reusable ballistic launcher concept for
Automatic generation of stochastica modes for large-scale structures  REMOTE CONTROL.  Traction-drive telerobot for space m. [DE87-005326] Telerobotic work system: Concept evolution  REMOTE HANDLING A master-slave manipulator system for [AIAA PAPER 87-1677]  REMOTE MANIPULATOR SYSTEM Development of sensors for remote rof Japanese Experiment Module Robots on the Space Station Japanese Experiment Module (JEM) status Development of a small-sized space	p 117 N87-29157  illy dominant failure p 149 A87-37853  anipulation p 102 N87-22233 t development and p 104 N87-29866  for space use p 147 A87-32546 the Space Station p 100 A87-41153  manipulator system p 147 A87-32547 p 100 A87-40844 preliminary design p 151 A87-41570	REPLENISHMENT A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677 REQUIREMENTS High power/large area PV systems  p 80 N87-26452 Space Station end effector strategy study [NASA-TM-100488] p 103 N87-29593 RESCUE OPERATIONS A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677 RESEARCH AND DEVELOPMENT Space research - At a crossroads  p 166 A87-32017 Design and development of a Space Station proximity operations research and development mockup [SAE PAPER 861785] p 133 A87-32634 K.E. Tsiolkovskii and problems in the development of science and technology Russian book p 151 A87-40342 Advanced technology for the Space Station	Wave propagation in periodic truss structures  [AIAA PAPER 87-0944] p 18 A87-33742  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714  Commit your works to the Lord, and your thoughts shall be established (Prov. 16:3). Inter-stable control systems p 9 N87-22716  RESONANT VIBRATION  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  RETRACTABLE EQUIPMENT  EURECA application of the Retractable Advanced Rigid Array (RARA) solar array p 32 N87-29973  The extendable and retractable mast as supporting tool for rigid solar arrays p 39 N87-29012  REUSABLE LAUNCH VEHICLES  The single-stage reusable ballistic launcher concept for economic cargo transportation p 135 A87-41573
Automatic generation of stochastica modes for large-scale structures  REMOTE CONTROL.  Traction-drive telerobot for space m [DE87-005326]  Telerobotic work system: Concept evolution  REMOTE HANDLING  A master-slave manipulator system for [AIAA PAPER 87-1677]  REMOTE MANIPULATOR SYSTEM  Development of sensors for remote r of Japanese Experiment Module (JEM) status  Development of a small-sized space Use of a video-photogrammetry	p 117 N87-29157  Illy dominant failure p 149 A87-37853  Inipulation p 102 N87-22233 t development and p 104 N87-29866  for space use p 147 A87-32546 the Space Station p 100 A87-41153  manipulator system p 147 A87-32547 p 100 A87-40844 preliminary design p 151 A87-41570 p manipulator p 101 A87-51979 system for the	REPLENISHMENT  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  REQUIREMENTS  High power/large area PV systems  p 80 N87-26452  Space Station end effector strategy study [NASA-TM-100488] p 103 N87-29593  RESCUE OPERATIONS  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  RESEARCH AND DEVELOPMENT  Space research - At a crossroads  p 166 A87-32017  Design and development of a Space Station proximity operations research and development mockup [SAE PAPER 861785] p 133 A87-3634  K.E. Tsiolkovskii and problems in the development of science and technology Russian book p 151 A87-40342  Advanced technology for the Space Station p 120 A87-40353	Wave propagation in periodic truss structures  [AIAA PAPER 87-0944] p 18 A87-33742  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714  Commit your works to the Lord, and your thoughts shall be established (Prov. 16:3). Inter-stable control systems p 9 N87-22716  RESONANT VIBRATION  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  RETRACTABLE EQUIPMENT  EURECA application of the Retractable Advanced Rigid Array (RARA) solar array p 82 N87-28973  The extendable and retractable mast as supporting tool for rigid solar arrays p 39 N87-29012  REUSABLE LAUNCH VEHICLES  The single-stage reusable ballistic launcher concept for economic cargo transportation p 135 A87-41573  REUSABLE SPACECRAFT  The SERVICE concept p 134 A87-36362
Automatic generation of stochastica modes for large-scale structures  REMOTE CONTROL.  Traction-drive telerobot for space m. [DE87-005326] Telerobotic work system: Concept evolution  REMOTE HANDLING A master-slave manipulator system for [AIAA PAPER 87-1677]  REMOTE MANIPULATOR SYSTEM Development of sensors for remote rof Japanese Experiment Module Robots on the Space Station Japanese Experiment Module (JEM) status Development of a small-sized space  Use of a video-photogrammetry measurement of the dynamic respon	p 117 N87-29157  tilly dominant failure p 149 A87-37853  anipulation p 102 N87-22233 t development and p 104 N87-29866  for space use p 147 A87-32546 the Space Station p 100 A87-41153  manipulator system p 147 A87-32547 p 100 A87-40844 preliminary design p 151 A87-41570 p manipulator p 101 A87-51979 system for the se of the shuttle	REPLENISHMENT  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106]  REQUIREMENTS  High power/large area PV systems  p 80 N87-26452  Space Station end effector strategy study [NASA-TM-100488] p 103 N87-29593  RESCUE OPERATIONS  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  RESEARCH AND DEVELOPMENT  Space research - At a crossroads  Design and development of a Space Station proximity operations research and development mockup  [SAE PAPER 861785] p 133 A87-32634  K.E. Tsiolkovskii and problems in the development of science and technology Russian book  p 151 A87-40342  Advanced technology for the Space Station p 120 A87-40353  1987 status report - United States Air Force electric	Wave propagation in periodic truss structures  [AIAA PAPER 87-0944] p 18 A87-33742  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714  Commit your works to the Lord, and your thoughts shall be established (Prov. 16:3). Inter-stable control systems p 9 N87-22716  RESONANT VIBRATION  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  RETRACTABLE EQUIPMENT  EURECA application of the Retractable Advanced Rigid Array (RARA) solar array p 82 N87-28973  The extendable and retractable mast as supporting tool for rigid solar arrays  The estage reusable ballistic launcher concept for economic cargo transportation p 135 A87-41573  REUSABLE SPACECRAFT  The SERVICE concept p 134 A87-36362  The capabilities of Eureca thermal control for future
Automatic generation of stochastica modes for large-scale structures  REMOTE CONTROL.  Traction-drive telerobot for space m. [DE87-005326] Telerobotic work system: Concept evolution  REMOTE HANDLING A master-slave manipulator system for [AIAA PAPER 87-1677]  REMOTE MANIPULATOR SYSTEM Development of sensors for remote r of Japanese Experiment Module Robots on the Space Station Japanese Experiment Module (JEM) status Development of a small-sized space  Use of a video-photogrammetry measurement of the dynamic respon	p 117 N87-29157  Illy dominant failure p 149 A87-37853  Inipulation p 102 N87-22233 It development and p 104 N87-29866  for space use p 147 A87-32546 It space Station p 100 A87-41153  Imanipulator system p 147 A87-32547 p 100 A87-4844 preliminary design p 151 A87-41570 p manipulator p 101 A87-51979 system for the ise of the shuttle p 101 N87-20370	REPLENISHMENT  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  REQUIREMENTS  High power/large area PV systems  p 80 N87-26452  Space Station end effector strategy study [NASA-TM-100488] p 103 N87-29593  RESCUE OPERATIONS  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  RESEARCH AND DEVELOPMENT  Space research - At a crossroads  p 166 A87-32017  Design and development of a Space Station proximity operations research and development mockup [SAE PAPER 861785] p 133 A87-3634  K.E. Tsiolkovskii and problems in the development of science and technology Russian book p 151 A87-40342  Advanced technology for the Space Station p 120 A87-40353	Wave propagation in periodic truss structures  [AIAA PAPER 87-0944] p 18 A87-33742  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714  Commit your works to the Lord, and your thoughts shall be established (Prov. 16:3). Inter-stable control systems p 9 N87-22716  RESONANT VIBRATION  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  RETRACTABLE EQUIPMENT  EURECA application of the Retractable Advanced Rigid Array (RARA) solar array p 82 N87-28973  The extendable and retractable mast as supporting tool for rigid solar arrays p 39 N87-29012  REUSABLE LAUNCH VEHICLES  The single-stage reusable ballistic launcher concept for economic cargo transportation p 135 A87-41573  REUSABLE SPACECRAFT  The SERVICE concept p 134 A87-36362  The capabilities of Eureca thermal control for future mission scenarios
Automatic generation of stochastica modes for large-scale structures  REMOTE CONTROL.  Traction-drive telerobot for space m [DE87-005326] Telerobotic work system: Concept evolution  REMOTE HANDLING A master-slave manipulator system for [AIAA PAPER 87-1677]  REMOTE MANIPULATOR SYSTEM Development of sensors for remote of Japanese Experiment Module Robots on the Space Station Japanese Experiment Module (JEM) status Development of a small-sized space Use of a video-photogrammetry measurement of the dynamic respon remote manipulator arm	p 117 N87-29157  Illy dominant failure p 149 A87-37853  Inipulation p 102 N87-22233 t development and p 104 N87-29866  for space use p 147 A87-32546 the Space Station p 100 A87-41153  manipulator system p 147 A87-32547 p 100 A87-40844 preliminary design p 151 A87-41570 e manipulator p 101 A87-51979 system for the use of the shuttle p 101 N87-20370 of a space station uts	REPLENISHMENT  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106]  REQUIREMENTS  High power/large area PV systems  p 80 N87-26452  Space Station end effector strategy study [NASA-TM-100488]  p 103 N87-29593  RESCUE OPERATIONS  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106]  RESEARCH AND DEVELOPMENT  Space research - At a crossroads  p 166 A87-32017  Design and development of a Space Station proximity operations research and development mockup [SAE PAPER 861785]  K.E. Tsiolkovskii and problems in the development of science and technology Russian book  p 151 A87-40342  Advanced technology for the Space Station  p 120 A87-40353  1987 status report - United States Air Force electric propulsion research and development [AIAA PAPER 87-1036]  p 90 A87-41122  Technical and Management Information System	Wave propagation in periodic truss structures  [AIAA PAPER 87-0944] p 18 A87-33742  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714  Commit your works to the Lord, and your thoughts shall be established (Prov. 16:3). Inter-stable control systems p 9 N87-22716  RESONANT VIBRATION  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  RETRACTABLE EQUIPMENT  EURECA application of the Retractable Advanced Rigid Array (RARA) solar array p 82 N87-28973  The extendable and retractable mast as supporting tool for rigid solar arrays  The estage reusable ballistic launcher concept for economic cargo transportation p 135 A87-41573  REUSABLE SPACECRAFT  The SERVICE concept p 134 A87-36362  The capabilities of Eureca thermal control for future
Automatic generation of stochastica modes for large-scale structures  REMOTE CONTROL.  Traction-drive telerobot for space m [DE87-005326] Telerobotic work system: Concept evolution  REMOTE HANDLING A master-slave manipulator system for [AIAA PAPER 87-1677]  REMOTE MANIPULATOR SYSTEM Development of sensors for remote of Japanese Experiment Module Robots on the Space Station Japanese Experiment Module (JEM) status Development of a small-sized space Use of a video-photogrammetry measurement of the dynamic respon remote manipulator arm Design, construction, and utilization assembled from 5-meter erectable structure.	p 117 N87-29157  Illy dominant failure p 149 A87-37853  Inipulation p 102 N87-22233 It development and p 102 N87-22233 It development and p 104 N87-29866  for space use p 147 A87-32546 It space Station p 100 A87-41153  Imanipulator system p 147 A87-32547 p 100 A87-40844 p reliminary design p 151 A87-41570 p 101 A87-41570 p 101 A87-51979 system for the se of the shuttle p 101 N87-20370 of a space station uts p 34 N87-24501	REPLENISHMENT  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  REQUIREMENTS  High power/large area PV systems  p 80 N87-26452  Space Station end effector strategy study [NASA-TM-100488] p 103 N87-29593  RESCUE OPERATIONS  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  RESEARCH AND DEVELOPMENT  Space research - At a crossroads  p 166 A87-32017  Design and development of a Space Station proximity operations research and development mockup [SAE PAPER 861785] p 133 A87-32634  K.E. Tsiolkovskii and problems in the development of science and technology Russian book  p 151 A87-40342  Advanced technology for the Space Station  p 120 A87-40353  1987 status report - United States Air Force electric propulsion research and development [AIAA PAPER 87-1036] p 90 A87-41122  Technical and Management Information System (TMIS)	Wave propagation in periodic truss structures  [AIAA PAPER 87-0944] p 18 A87-33742  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714  Commit your works to the Lord, and your thoughts shall be established (Prov. 16:3). Inter-stable control systems p 9 N87-22716  RESONANT VIBRATION  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  RETRACTABLE EQUIPMENT  EURECA application of the Retractable Advanced Rigid Array (RARA) solar array p 82 N87-28973  The extendable and retractable mast as supporting tool for rigid solar arrays p 39 N87-29012  REUSABLE LAUNCH VEHICLES  The single-stage reusable ballistic launcher concept for economic cargo transportation p 135 A87-41573  REUSABLE SPACECRAFT  The SERVICE concept p 134 A87-36362  The capabilities of Eureca thermal control for future mission scenarios  [SAE PAPER 860936] p 42 A87-38725  Design parameters and environmental considerations for a reusable aeroassisted orbital transfer vehicle
Automatic generation of stochastica modes for large-scale structures  REMOTE CONTROL.  Traction-drive telerobot for space m [DE87-005326] Telerobotic work system: Concept evolution  REMOTE HANDLING A master-slave manipulator system for [AIAA PAPER 87-1677]  REMOTE MANIPULATOR SYSTEM Development of sensors for remote r of Japanese Experiment Module Robots on the Space Station Japanese Experiment Module (JEM) status Development of a small-sized space Use of a video-photogrammetry measurement of the dynamic respon remote manipulator arm Design, construction, and utilization assembled from 5-meter erectable structure.	p 117 N87-29157  Illy dominant failure p 149 A87-37853  Inipulation p 102 N87-22233 It development and p 102 N87-22233 It development and p 104 N87-29866  for space use p 147 A87-32546 It space Station p 100 A87-41153  Imanipulator system p 147 A87-32547 p 100 A87-40844 p reliminary design p 151 A87-41570 p 101 A87-41570 p 101 A87-51979 system for the se of the shuttle p 101 N87-20370 of a space station uts p 34 N87-24501	REPLENISHMENT A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677 REQUIREMENTS High power/large area PV systems  p 80 N87-26452 Space Station end effector strategy study [NASA-TM-100488] p 103 N87-29593 RESCUE OPERATIONS A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677 RESEARCH AND DEVELOPMENT Space research - At a crossroads  p 166 A87-32017 Design and development of a Space Station proximity operations research and development mockup [SAE PAPER 861785] p 133 A87-32634 K.E. Tsiolkovskii and problems in the development of science and technology Russian book p 151 A87-40342 Advanced technology for the Space Station p 120 A87-40353 1987 status report - United States Air Force electric propulsion research and development [AIAA PAPER 87-1036] p 90 A87-41122 Technical and Management Information System (TMIS) [AIAA PAPER 87-2217] p 114 A87-48600	Wave propagation in periodic truss structures  [AIAA PAPER 87-0944] p 18 A87-33742  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-46714  Commit your works to the Lord, and your thoughts shall be established (Prov. 16:3). Inter-stable control systems p 9 N87-22716  RESONANT VIBRATION  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  RETRACTABLE EQUIPMENT  EURECA application of the Retractable Advanced Rigid Array (RARA) solar array p 82 N87-28973  The extendable and retractable mast as supporting tool for rigid solar arrays p 39 N87-29012  REUSABLE LAUNCH VEHICLES  The single-stage reusable ballistic launcher concept for economic cargo transportation p 135 A87-41573  REUSABLE SPACECRAFT  The SERVICE concept p 134 A87-36362  The capabilities of Eureca thermal control for future mission scenarios  [SAE PAPER 860936] p 42 A87-38725  Design parameters and environmental considerations for a reusable aeroassisted orbital transfer vehicle  [AIAA PAPER 87-1505] p 160 A87-43031
Automatic generation of stochastica modes for large-scale structures  REMOTE CONTROL.  Traction-drive telerobot for space m. [DE87-005326] Telerobotic work system: Concept evolution REMOTE HANDLING A master-slave manipulator system for [AIAA PAPER 87-1677] REMOTE MANIPULATOR SYSTEM Development of sensors for remote r of Japanese Experiment Module Robots on the Space Station Japanese Experiment Module (JEM) status Development of a small-sized space Use of a video-photogrammetry measurement of the dynamic respon remote manipulator arm Design, construction, and utilization assembled from 5-meter erectable structure of manipulator system.	p 117 N87-29157  Illy dominant failure p 149 A87-37853  Inipulation p 102 N87-22233 It development and p 102 N87-22233 It development and p 104 N87-29866  for space use p 147 A87-32546 It space Station p 100 A87-41153  Imanipulator system p 147 A87-32547 p 100 A87-40844 p reliminary design p 151 A87-41570 p 101 A87-41570 p 101 A87-51979 system for the se of the shuttle p 101 N87-20370 of a space station uts p 34 N87-24501	REPLENISHMENT  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  REQUIREMENTS  High power/large area PV systems  p 80 N87-26452  Space Station end effector strategy study [NASA-TM-100488] p 103 N87-29593  RESCUE OPERATIONS  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  RESEARCH AND DEVELOPMENT  Space research - At a crossroads  p 166 A87-32017  Design and development of a Space Station proximity operations research and development mockup [SAE PAPER 861785] p 133 A87-32634  K.E. Tsiolkovskii and problems in the development of science and technology Russian book  p 151 A87-40342  Advanced technology for the Space Station  p 120 A87-40353  1987 status report - United States Air Force electric propulsion research and development [AIAA PAPER 87-1036] p 90 A87-41122  Technical and Management Information System (TMIS)	Wave propagation in periodic truss structures  [AIAA PAPER 87-0944] p 18 A87-33742  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714  Commit your works to the Lord, and your thoughts shall be established (Prov. 16:3). Inter-stable control systems p 9 N87-22716  RESONANT VIBRATION  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  RETRACTABLE EQUIPMENT  EURECA application of the Retractable Advanced Rigid Array (RARA) solar array p 82 N87-28973  The extendable and retractable mast as supporting tool for rigid solar arrays p 39 N87-29012  REUSABLE LAUNCH VEHICLES  The single-stage reusable ballistic launcher concept for economic cargo transportation p 135 A87-41573  REUSABLE SPACECRAFT  The SERVICE concept p 134 A87-36362  The capabilities of Eureca thermal control for future mission scenarios  [SAE PAPER 860936] p 42 A87-38725  Design parameters and environmental considerations for a reusable aeroassisted orbital transfer vehicle
Automatic generation of stochastica modes for large-scale structures  REMOTE CONTROL.  Traction-drive telerobot for space m [DE87-005326] Telerobotic work system: Concept evolution  REMOTE HANDLING A master-slave manipulator system for [AIAA PAPER 87-1677]  REMOTE MANIPULATOR SYSTEM Development of sensors for remote r of Japanese Experiment Module Robots on the Space Station Japanese Experiment Module (JEM) status Development of a small-sized space Use of a video-photogrammetry measurement of the dynamic respon remote manipulator arm Design, construction, and utilization assembled from 5-meter erectable structure.  Track and capture of the orbiter with remote manipulator system [NASA-TM-89221] Remote handling facility and equipm	p 117 N87-29157  illy dominant failure p 149 A87-37853  anipulation p 102 N87-22233 t development and p 102 N87-22233 t development and p 104 N87-29866  for space use p 147 A87-32546 the Space Station p 100 A87-41153  manipulator system p 147 A87-32547 p 100 A87-40844 p reliminary design p 151 A87-41570 p 101 A87-51579 system for the see of the shuttle p 101 N87-20370 of a space station uts p 34 N87-24501 n the space station p 137 N87-25339	REPLENISHMENT A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677 REQUIREMENTS High power/large area PV systems  p 80 N87-26452 Space Station end effector strategy study [NASA-TM-100488] p 103 N87-29593 RESCUE OPERATIONS A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677 RESEARCH AND DEVELOPMENT Space research - At a crossroads  p 166 A87-32017 Design and development of a Space Station proximity operations research and development mockup [SAE PAPER 861786] p 133 A87-32634 K.E. Tsiolkovskii and problems in the development of science and technology Russian book  p 151 A87-40342 Advanced technology for the Space Station  p 120 A87-40353 1987 status report - United States Air Force electric propulsion research and development [AIAA PAPER 87-1036] p 99 A87-41122 Technical and Management Information System (TMIS) [AIAA PAPER 87-2217] p 114 A87-48600 Development of a small-sized space manipulator  p 101 A87-51979 Developing Space Station. II - Power, rendezvous,	Wave propagation in periodic truss structures [AIAA PAPER 87-0944] p 18 A87-33742 Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121 Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714 Commit your works to the Lord, and your thoughts shall be established (Prov. 16:3). Inter-stable control systems p 9 N87-22716  RESONANT VIBRATION Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  RETRACTABLE EQUIPMENT EURECA application of the Retractable Advanced Rigid Array (RARA) solar array p 82 N87-28973 The extendable and retractable mast as supporting tool for rigid solar arrays p 39 N87-29012  REUSABLE LAUNCH VEHICLES The single-stage reusable ballistic launcher concept for economic cargo transportation p 135 A87-41573  REUSABLE SPACECRAFT The SERVICE concept p 134 A87-36362 The capabilities of Eureca thermal control for future mission scenarios  [SAE PAPER 860936] p 42 A87-38725  Design parameters and environmental considerations for a reusable aeroassisted orbital transfer vehicle  [AIAA PAPER 87-1505] p 160 A87-43031  REUSE  Results on reuse of reclaimed shower water  [SAE PAPER 860983] p 50 A87-38762
Automatic generation of stochastica modes for large-scale structures  REMOTE CONTROL.  Traction-drive telerobot for space m [DE87-005326] Telerobotic work system: Concept evolution REMOTE HANDLING A master-slave manipulator system for [AIAA PAPER 87-1677] REMOTE MANIPULATOR SYSTEM Development of sensors for remote r of Japanese Experiment Module Robots on the Space Station Japanese Experiment Module (JEM) status Development of a small-sized space Use of a video-photogrammetry measurement of the dynamic respon remote manipulator arm Design, construction, and utilization assembled from 5-meter erectable structure.  Track and capture of the orbiter with remote manipulator system [NASA-TM-89221] Remote handling facility and equipm truss assembly	p 117 N87-29157  illy dominant failure p 149 A87-37853  anipulation p 102 N87-22233 t development and p 102 N87-22233 t development and p 104 N87-29866  for space use p 147 A87-32546 the Space Station p 100 A87-41153  manipulator system p 147 A87-32547 p 100 A87-40844 p reliminary design p 151 A87-41570 p 101 A87-51579 system for the see of the shuttle p 101 N87-20370 of a space station uts p 34 N87-24501 n the space station p 137 N87-25339	REPLENISHMENT  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment (AD-A179106)  REQUIREMENTS  High power/large area PV systems  p 80 N87-26452  Space Station end effector strategy study (NASA-TM-100488)  RESCUE OPERATIONS  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment (AD-A179106)  p 161 N87-23677  RESEARCH AND DEVELOPMENT  Space research - At a crossroads  p 166 A87-32017  Design and development of a Space Station proximity operations research and development mockup (SAE PAPER 861785)  p 133 A87-32634  K.E. Tsiolkovskii and problems in the development of science and technology Russian book  p 151 A87-40342  Advanced technology for the Space Station  p 120 A87-40353  1987 status report - United States Air Force electric propulsion research and development (AIAA PAPER 87-1036)  Technical and Management Information System (TMIS)  [AIAA PAPER 87-2217]  Development of a small-sized space manipulator  p 101 A87-51979	Wave propagation in periodic truss structures  [AIAA PAPER 87-0944] p 18 A87-33742  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714  Commit your works to the Lord, and your thoughts shall be established (Prov. 16:3). Inter-stable control systems p 9 N87-22716  RESONANT VIBRATION  Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with attached rigid bodies p 152 A87-46121  RETRACTABLE EQUIPMENT  EURECA application of the Retractable Advanced Rigid Array (RARA) solar array p 82 N87-28973  The extendable and retractable mast as supporting tool for rigid solar arrays p 39 N87-29012  REUSABLE LAUNCH VEHICLES  The single-stage reusable ballistic launcher concept for economic cargo transportation p 135 A87-41573  REUSABLE SPACECRAFT  The SERVICE concept p 134 A87-36362  The capabilities of Eureca thermal control for future mission scenarios  [SAE PAPER 860936] p 42 A87-38725  Design parameters and environmental considerations for a reusable aeroassisted orbital transfer vehicle  [AIAA PAPER 87-1505] p 160 A87-43031  REUSE  Results on reuse of reclaimed shower water

RIGID STRUCTURES	Robust eigensystem assignment for flexible structures	SALYUT SPACE STATION
An equivalent continuum analysis procedure for Space	[AIAA PAPER 87-2252] p 23 A87-50416	Gravity-gradient stabilization of the Salyut 6-Soyuz orbital complex p 147 A87-32801
Station lattice structures	Robust control of a large space antenna	orbital complex p 147 A87-32801 Contribution of the German Democratic Republic (East
[AIAA PAPER 87-0724] p 13 A87-33564 Determination of the natural frequencies of the	[AIAA PAPER 87-2253] p 86 A87-50417	Germany) to the 'Intercosmos' program of study of
longitudinal and torsional vibrations of truss structures with	Integrated control/structure design and robustness p 65 N87-22060	materials in space aboard the orbiting station Salyut 6
attached rigid bodies p 152 A87-46121	ROCKET ENGINE DESIGN	p 147 A87-32814
The dynamics and control of the Space Station polar	CP/MPS - Contained plasma magnetic propulsion	Evaluation of physical work capacity of cosmonauts aboard Salyut-6 station p 157 N87-20735
platform	system: An advanced propulsion concept	USSR Report: Space
[AIAA PAPER 87-2600] p 62 A87-50562	[AIAA PAPER 87-1042] p 89 A87-38016	[JPRS-USP-86-004] p 158 N87-27687
Variable structure control system maneuvering of spacecraft p 64 N87-21989	Status and tendencies for low to medium thrust	Pravda commentary, photos of Mir orbital station
Substructure analysis using NICE/SPAR and	propulsion systems [IAF PAPER 86-162] p 90 A87-42680	p 158 N87-27688
applications of force to linear and nonlinear structures	[IAF PAPER 86-162] p 90 A87-42680  Thermal design of a large spacecraft propulsion	Progress in theory, technology of space materials science p 158 N87-27695
spacecraft masts	system	science p 158 N87-27695 SATELLITE ANTENNAS
[NASA-CR-180317] p 38 N87-27260	[AIAA PAPER 87-1863] p 44 A87-45258	Thermal deformation and electrical degradation of
EURECA application of the Retractable Advanced Rigid Array (RARA) solar array p 82 N87-28973	Concepts for space maintenance of OTV engines	antenna reflector with truss backstructure
Array (RARA) solar array p 82 N87-28973  The INMARSAT solar array: The first Advanced Rigid	p 136 A87-46000	p 12 A87-32405
Array (ARA) to fly p 82 N87-28975	Structure and design of spacecraft Russian book	Precise pointing control of flexible spacecraft
The Fokker Strongback solar array p 82 N87-28979	p 155 A87-51870	p 55 A87-32446
The extendable and retractable mast as supporting tool	ROCKET ENGINES	Design considerations for a one-kilometer antenna stick
for rigid solar arrays p 39 N87-29012	Optimal shuttle altitude changes using tethers	[AIAA PAPER 87-0871] p 15 A87-33635
RIT ENGINES	[AD-A179205] p 129 N87-22756	On-board K- and S-band multi-beam antennas
Status of the RITA - Experiment on EURECA Radio Frequency Ion Thrustor Assembly	Concepts for space maintenance of OTV engines p 137 N87-26097	p 86 A87-46281
[AIAA PAPER 87-0988] p 123 A87-38002	·	Design of a beacon receiving system for the Olympus
ROBOTICS	ROCKET EXHAUST  Resistojet plume and induced environment analysis	satellite p 86 A87-50157
A master-slave manipulator system for space use	[NASA-TM-88957] p 96 N87-24536	Summary of recent SAR instrument studies p 159 N87-27865
p 147 A87-32546	ROCKET NOZZLES	SATELLITE ATTITUDE CONTROL
System architecture for the telerobotic work system	Evaluation of carbon-carbon for space engine nozzle	A review of modelling techniques for the open and
[AAS PAPER 86-044] p 99 A87-32746 Overview of the NASA automation and robotics research	p 98 N87-26116	closed-loop dynamics of large space systems
program p 100 A87-33867	ROCKET PROPELLANTS	p 12 A87-32337
Manned spacecraft automation and robotics	Preliminary performance characterizations of an	Space Infrared Telescope Facility/Multimission Modular
p 100 A87-37300	engineering model multipropellant resistojet for space	Spacecraft Attitude Control System conceptual design [AAS PAPER 86-031] p 56 A87-32736
Planning for space robotics developments and	station application [AIAA PAPER 87-2120] p 93 A87-50197	[AAS PAPER 86-031] p 56 A87-32736  Dynamic and attitude control characteristics of an
applications p 135 A87-40377	Overview: Fluid acquisition and transfer	International Space Station
An integrated approach to spacecraft design for robotic	p 94 N87-21146	[AIAA PAPER 87-0931] p 57 A87-33731
servicing [AIAA PAPER 87-1672] p 100 A87-41152	A 2000-hour cyclic endurance test of a laboratory model	Choice of the optimal angular position of a spacecraft
[AIAA PAPER 87-1672] p 100 A87-41152 The Canadian Robotic System for the Space Station	multipropellant resistojet	in the constant-solar-orientation flight segment
[AIAA PAPER 87-1677] p 100 A87-41153	[NASA-TM-89854] p 96 N87-22237	p 148 A87-34207
Space: New opportunities for all people; Selected	Preliminary performance characterizations of an	Attitude control of a spacecraft using an extended self-organizing fuzzy logic controller p 59 A87-41617
Proceedings of the Thirty-seventh International	engineering model multipropellant resistojet for space	Comparison of different attitude control schemes for
Astronautical Congress, Innsbruck, Austria, Oct. 4-11,	station application [NASA-TM-100113] p 96 N87-23821	large communications satellites
1986 p 168 A87-41568 Robotic telepresence p 100 A87-46704	[,, ,	[AIAA PAPER 87-2391] p 61 A87-50475
Robotic telepresence p 100 A87-46704 Space Station autonomy - What are the challenges?	ROCKET TEST FACILITIES  Space Station propulsion system test bed and control	Global treatment of energy dissipation effects for
How can they be met? p 101 A87-53059	system testing results	multibody satellites p 62 A87-51610
The Oak Ridge National Laboratory's Robotics and	[AIAA PAPER 87-1858] p 91 A87-45255	Attitude and Orientation System (AOCS) tasks on
Intelligent Systems Program	Space station propulsion test bed: A complete system	Rendezvous and Docking (RVD) (docking-undocking phases). Architecture of the whole simulator, volume 2
[DE87-004627] p 101 N87-20774	p 98 N87-26131	[LP-RP-Al-204-VOL-2] p 68 N87-24490
Service Manipulator Arm (SMA) for a Robotic Servicing	RODS	Attitude and Orientation Control System (AOCS) tasks
Experiment (ROSE) [ESA-CR(P)-2347] p 103 N87-28260	Critical length for stable elongated orbiting structures p 148 A87-32819	on Rendezvous and Docking (RVD) (docking-undocking
Space Station end effector strategy study	Dynamics of flexible structures performing large overall	phases). Simulation set-up and results, volume 3
[NASA-TM-100488] p 103 N87-29593	motions: A geometrically-nonlinear approach	[LP-RP-Al-204-VOL-3] p 69 N87-24491
The 21st Aerospace Mechanisms Symposium	p 64 N87-21335	Attitude and Orientation Control System (AOCS) tasks on Rendezvous and Docking (RVD) (docking-undocking
[NASA-CP-2470] p 103 N87-29858	ROLLER BEARINGS	phases). Docking-undocking phase analysis
Development of a standard connector for orbital replacement units for serviceable spacecraft		
	Space Station alpha joint bearing p 83 N87-29882	
n 40 N87-29864	ROTATING BODIES	[LP-RP-AI-204-VOL-1] p 70 N87-24514 Dynamics of an actively controlled flexible Earth
p 40 N87-29864	ROTATING BODIES  High speed simulation of multi-flexible-body systems	[LP-RP-AI-204-VOL-1] p 70 N87-24514  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356
p 40 N87-29864 Telerobotic work system: Concept development and evolution p 104 N87-29866	ROTATING BODIES  High speed simulation of multi-flexible-body systems with large rotations	[LP-RP-Al-204-VOL-1] p 70 N87-24514 Dynamics of an actively controlled flexible Earth observation satellitie p 71 N87-25356 Sampled nonlinear control for large angle maneuvers
p 40 N87-29864 Telerobotic work system: Concept development and evolution p 104 N87-29866 Traction-drive, seven-degree-of-freedom telerobot arm:	High speed simulation of multi-flexible-body systems with large rotations [AIAA PAPER 87-0930] p 57 A87-33730	[LP-RP-Al-204-VOL-1] p 70 N87-24514  Dynamics of an actively controlled flexible Earth p 71 N87-25356  Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358
p 40 N87-29864 Telerobotic work system: Concept development and evolution p 104 N87-29866 Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867	ROTATING BODIES  High speed simulation of multi-flexible-body systems with large rotations	[LP-RP-Al-204-VOL-1] p 70 N87-24514  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  SATELLITE COMMUNICATION
Telerobotic work system: Concept development and evolution p 104 N87-29866 Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867 ROBOTS	High speed simulation of multi-flexible-body systems with large rotations [AIAA PAPER 87-0930] p 57 A87-33730 Experiences of CNES and SEP on space mechanisms rotating at low speed p 104 N87-29868 ROTATING SHAFTS	[LP-RP-Al-204-VOL-1] p 70 N87-24514  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  SATELLITE COMMUNICATION  Communication missions for geostationary platforms p 84 A87-34797
Telerobotic work system: Concept development and evolution p 104 N87-29866 Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867  ROBOTS ROBOTS ROBOTS p 100 A87-40844	High speed simulation of multi-flexible-body systems with large rotations [AIAA PAPER 87-0930] p 57 A87-33730 Experiences of CNES and SEP on space mechanisms rotating at low speed p 104 N87-29868 ROTATING SHAFTS Common drive unit p 104 N87-29869	[LP-RP-Al-204-VOL-1] p 70 N87-24514  Dynamics of an actively controlled flexible Earth p 71 N87-25356  Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  SATELLITE COMMUNICATION  Communication missions for geostationary platforms p 84 A87-34797  Japan's space development programs for
Telerobotic work system: Concept development and evolution p 104 N87-29866 Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867 ROBOTS Robots on the Space Station p 100 A87-40844 Control of robot manipulator compliance	ROTATING BODIES  High speed simulation of multi-flexible-body systems with large rotations  [AIAA PAPER 87-0930] p 57 A87-33730  Experiences of CNES and SEP on space mechanisms rotating at low speed p 104 N87-29868  ROTATING SHAFTS  Common drive unit p 104 N87-29869  ROTATION	[LP-RP-Al-204-VOL-1] p 70 N87-24514  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  SATELLITE COMMUNICATION  Communication missions for geostationary platforms p 84 A87-34797  Japan's space development programs for communications - An overview p 152 A87-43156
Telerobotic work system: Concept development and evolution p 104 N87-29864 Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867  ROBOTS Robots on the Space Station p 100 A87-40844 Control of robot manipulator compliance p 100 A87-45797	High speed simulation of multi-flexible-body systems with large rotations [AIAA PAPER 87-0930] p 57 A87-33730 Experiences of CNES and SEP on space mechanisms rotating at low speed p 104 N87-29868 ROTATING SHAFTS Common drive unit p 104 N87-29869 ROTATION Suboptimal control of large flexible space structures	[LP-RP-Al-204-VOL-1] p 70 N87-24514  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  SATELLITE COMMUNICATION  Communication missions for geostationary platforms p 84 A87-34797  Japan's space development p 752 A87-343156  An advanced geostationary communications platform
Telerobotic work system: Concept development and evolution p 104 N87-29866 Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867 ROBOTS Robots on the Space Station p 100 A87-40844 Control of robot manipulator compliance	High speed simulation of multi-flexible-body systems with large rotations [AIAA PAPER 87-0930] p 57 A87-33730 Experiences of CNES and SEP on space mechanisms rotating at low speed p 104 N87-29868 ROTATING SHAFTS Common drive unit p 104 N87-29869 ROTATION Suboptimal control of large flexible space structures experiencing rotational dynamics nonlinearities	[LP-RP-Al-204-VOL-1] p 70 N87-24514  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  SATELLITE COMMUNICATION  Communication missions for geostationary platforms p 84 A87-34797  Japan's space development programs for communications - An overview p 152 A87-43156  An advanced geostationary communications platform p 125 A87-43165
Telerobotic work system: Concept development and evolution p 104 N87-29866 Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867  ROBOTS Robots on the Space Station p 100 A87-40844 Control of robot manipulator compliance p 100 A87-45797 The astronaut and the robot - Short- and long-term	High speed simulation of multi-flexible-body systems with large rotations [AIAA PAPER 87-0930] p 57 A87-33730 Experiences of CNES and SEP on space mechanisms rotating at low speed p 104 N87-29868  HOTATING SHAFTS Common drive unit p 104 N87-29869  ROTATION Suboptimal control of large flexible space structures experiencing rotational dynamics nonlinearities [AD-A180606] p 71 N87-25352	[LP-RP-Al-204-VOL-1] p 70 N87-24514  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  SATELLITE COMMUNICATION  Communication missions for geostationary platforms p 84 A87-34797  Japan's space development programs for communications - An overview p 152 A87-43156  An advanced geostationary communications platform p 125 A87-43165  Japanese data relay satellite system
Telerobotic work system: Concept development and evolution p 104 N87-29866 Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867  ROBOTS Robots on the Space Station p 100 A87-40844 Control of robot manipulator compliance p 100 A87-45797 The astronaut and the robot - Short- and long-term scenarios for space technology p 101 A87-53991 Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation	High speed simulation of multi-flexible-body systems with large rotations [AIAA PAPER 87-0930] p 57 A87-33730 Experiences of CNES and SEP on space mechanisms rotating at low speed p 104 N87-29868 ROTATING SHAFTS Common drive unit p 104 N87-29869 ROTATION Suboptimal control of large flexible space structures experiencing rotational dynamics nonlinearities [AD-A180606] p 71 N87-25352 ROTOR BLADES (TURBOMACHINERY) The effect of circumferential aerodynamic detuning on	[LP-RP-Al-204-VOL-1] p 70 N87-24514  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Sampled nonlinear control for large angle maneuvers of flexible spacecraft  SATELLITE COMMUNICATION  Communication missions for geostationary platforms p 84 A87-34797  Japan's space development programs for communications - An overview p 152 A87-43156  An advanced geostationary communications platform p 125 A87-43165  Japanese data relay satellite system  [AIAA PAPER 87-2199] p 154 A87-48585
Telerobotic work system: Concept development and evolution p 104 N87-29866 Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867  ROBOTS Robots on the Space Station p 100 A87-40844 Control of robot manipulator compliance p 100 A87-45797 The astronaut and the robot - Short- and long-term scenarios for space technology p 101 A87-53991 Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-22231	High speed simulation of multi-flexible-body systems with large rotations [AIAA PAPER 87-0930] p 57 A87-33730 Experiences of CNES and SEP on space mechanisms rotating at low speed p 104 N87-29868 ROTATION Suboptimal control of large flexible space structures experiencing rotational dynamics nonlinearities [AD-A180606] p 71 N87-25352 ROTOR BLADES (TURBOMACHINERY) The effect of circumferential aerodynamic detuning on coupled bending-torsion unstalled supersonic flutter	[LP-RP-Al-204-VOL-1] p 70 N87-24514  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  SATELLITE COMMUNICATION  Communication missions for geostationary platforms p 84 A87-34797  Japan's space development programs for communications - An overview p 152 A87-43156  An advanced geostationary communications platform p 125 A87-43165  Japanese data relay satellite system  [AIAA PAPER 87-2199] p 154 A87-48585  SATELLITE CONTROL
Telerobotic work system: Concept development and evolution p 104 N87-29866 Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulation in space p 104 N87-29867  ROBOTS Robots on the Space Station p 100 A87-40844 Control of robot manipulator compliance p 100 A87-45797  The astronaut and the robot - Short- and long-term scenarios for space technology p 101 A87-53991 Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-22231  Traction-drive telerobot for space manipulation	High speed simulation of multi-flexible-body systems with large rotations [AIAA PAPER 87-0930] p 57 A87-33730 Experiences of CNES and SEP on space mechanisms rotating at low speed p 104 N87-29868 ROTATING SHAFTS Common drive unit p 104 N87-29869 ROTATION Suboptimal control of large flexible space structures experiencing rotational dynamics nonlinearities [AD-A180606] p 71 N87-25352 ROTOR BLADES (TURBOMACHINERY) The effect of circumferential aerodynamic detuning on	[LP-RP-Al-204-VOL-1] p 70 N87-24514  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  SATELLITE COMMUNICATION  Communication missions for geostationary platforms p 84 A87-34797 programs for communications - An overview p 152 A87-43156  An advanced geostationary communications platform p 125 A87-43165  Japanese data relay satellite system [AIAA PAPER 87-2199] p 154 A87-48585  SATELLITE CONTROL Tethered satellite program control strategy
Telerobotic work system: Concept development and evolution p 104 N87-29866 Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867  ROBOTS Robots on the Space Station p 100 A87-40844 Control of robot manipulator compliance p 100 A87-45797 The astronaut and the robot - Short- and long-term scenarios for space technology Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-22231 Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-2233	High speed simulation of multi-flexible-body systems with large rotations  [AIAA PAPER 87-0930] p 57 A87-33730  Experiences of CNES and SEP on space mechanisms rotating at low speed p 104 N87-29868  ROTATING SHAFTS  Common drive unit p 104 N87-29869  ROTATION  Suboptimal control of large flexible space structures experiencing rotational dynamics nonlinearities  [AD-A180606] p 71 N87-25352  ROTOR BLADES (TURBOMACHINERY)  The effect of circumferential aerodynamic detuning on coupled bending-torsion unstalled supersonic flutter  [ASME PAPER 86-GT-100) p 166 A87-25396	[LP-RP-Al-204-VOL-1] p 70 N87-24514  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  SATELLITE COMMUNICATION  Communication missions for geostationary platforms p 84 A87-34797  Japan's space development programs for communications - An overview p 152 A87-43156  An advanced geostationary communications platform p 125 A87-43165  Japanese data relay satellite system  [AIAA PAPER 87-2199] p 154 A87-48585  SATELLITE CONTROL  Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570
Telerobotic work system: Concept development and evolution p 104 N87-29866  Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867  ROBOTS  Robots on the Space Station p 100 A87-40844  Control of robot manipulator compliance p 100 A87-45797  The astronaut and the robot - Short- and long-term scenarios for space technology Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulaton  [DE87-004616] p 101 N87-22231  Traction-drive telerobot for space manipulation  [DE87-005326] p 102 N87-22233  Telerobotic technology for nuclear and space	High speed simulation of multi-flexible-body systems with large rotations [AIAA PAPER 87-0930] p 57 A87-33730 Experiences of CNES and SEP on space mechanisms rotating at low speed p 104 N87-29868 ROTATION Suboptimal control of large flexible space structures experiencing rotational dynamics nonlinearities [AD-A180606] p 71 N87-25352 ROTOR BLADES (TURBOMACHINERY) The effect of circumferential aerodynamic detuning on coupled bending-torsion unstalled supersonic flutter	[LP-RP-Al-204-VOL-1] p 70 N87-24514  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  SATELLITE COMMUNICATION  Communication missions for geostationary platforms p 84 A87-34797 programs for communications - An overview p 152 A87-43156  An advanced geostationary communications platform p 125 A87-43165  Japanese data relay satellite system [AIAA PAPER 87-2199] p 154 A87-48585  SATELLITE CONTROL Tethered satellite program control strategy
Telerobotic work system: Concept development and evolution p 104 N87-29866 Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867 ROBOTS Robots on the Space Station p 100 A87-40844 Control of robot manipulator compliance p 100 A87-45797 The astronaut and the robot - Short- and long-term scenarios for space technology p 101 A87-53991 Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-22231 Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233 Telerobotic technology for nuclear and space applications	High speed simulation of multi-flexible-body systems with large rotations  [AIAA PAPER 87-0930] p 57 A87-33730  Experiences of CNES and SEP on space mechanisms rotating at low speed p 104 N87-29868  ROTATION SHAFTS  Common drive unit p 104 N87-29869  ROTATION Suboptimal control of large flexible space structures experiencing rotational dynamics nonlinearities  [AD-A180606] p 71 N87-25352  ROTOR BLADES (TURBOMACHINERY)  The effect of circumferential aerodynamic detuning on coupled bending-torsion unstalled supersonic flutter  [ASME PAPER 86-GT-100] p 166 A87-25396	[LP-RP-Al-204-VOL-1] p 70 N87-24514  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  SATELLITE COMMUNICATION  Communication missions for geostationary platforms p 84 A87-34797  Japan's space development programs for communications - An overview p 152 A87-34765  An advanced geostationary communications platform p 125 A87-43165  Japanese data relay satellite system  [AIAA PAPER 87-2199] p 154 A87-48585  SATELLITE CONTROL  Tethered satellite program control strategy  [AAS PAPER 86-221] p 123 A87-38570  A new concept of generalized structural filtering for
Telerobotic work system: Concept development and evolution p 104 N87-29864 Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867  ROBOTS Robots on the Space Station p 100 A87-40844 Control of robot manipulator compliance p 100 A87-45797 The astronaut and the robot - Short- and long-term scenarios for space technology p 101 A87-53991 Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-22231 Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233 Telerobotic technology for nuclear and space applications [NASA-CR-180923] p 102 N87-22242	High speed simulation of multi-flexible-body systems with large rotations [AIAA PAPER 87-0930] p 57 A87-33730 Experiences of CNES and SEP on space mechanisms rotating at low speed p 104 N87-29868 ROTATING SHAFTS Common drive unit p 104 N87-29869 ROTATION Suboptimal control of large flexible space structures experiencing rotational dynamics nonlinearities [AD-A180606] p 71 N87-25352 ROTOR BLADES (TURBOMACHINERY) The effect of circumferential aerodynamic detuning on coupled bending-torsion unstalled supersonic flutter [ASME PAPER 86-GT-100] p 166 A87-25396	[LP-RP-Al-204-VOL-1] p 70 N87-24514  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  SATELLITE COMMUNICATION  Communication missions for geostationary platforms p 84 A87-34797  Japan's space development programs for communications - An overview p 152 A87-34796  An advanced geostationary communications platform p 125 A87-43165  Japanese data relay satellite system  [AIAA PAPER 87-2199] p 154 A87-48585  SATELLITE CONTROL  Tethered satellite program control strategy  [AAS PAPER 86-221] p 123 A87-38570  A new concept of generalized structural filtering for active vibration control synthesis  [AIAA PAPER 87-2456] p 24 A87-50502  SATELLITE DESIGN
Telerobotic work system: Concept development and evolution p 104 N87-29866 Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867 ROBOTS Robots on the Space Station p 100 A87-40844 Control of robot manipulator compliance p 100 A87-45797 The astronaut and the robot - Short- and long-term scenarios for space technology p 101 A87-53991 Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-22231 Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233 Telerobotic technology for nuclear and space applications	High speed simulation of multi-flexible-body systems with large rotations  [AIAA PAPER 87-0930] p 57 A87-33730  Experiences of CNES and SEP on space mechanisms rotating at low speed p 104 N87-29868  ROTATING SHAFTS  Common drive unit p 104 N87-29869  ROTATION  Suboptimal control of large flexible space structures experiencing rotational dynamics nonlinearities  [AD-A180606] p 71 N87-25352  ROTOR BLADES (TURBOMACHINERY)  The effect of circumferential aerodynamic detuning on coupled bending-torsion unstalled supersonic flutter  [ASME PAPER 86-GT-100] p 166 A87-25396  SAFETY  20 kHz Space Station power system	[LP-RP-Al-204-VOL-1] p 70 N87-24514  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  SATELLITE COMMUNICATION  Communication missions for geostationary platforms p 84 A87-34797  Japan's space development programs for communications - An overview p 152 A87-43156  An advanced geostationary communications platform p 125 A87-43165  Japanese data relay satellite system  [AIAA PAPER 87-2199] p 154 A87-48585  SATELLITE CONTROL  Tethered satellite program control strategy  [AAS PAPER 86-221] p 123 A87-38570  A new concept of generalized structural filtering for active vibration control synthesis  [AIAA PAPER 87-2456] p 24 A87-50502  SATELLITE DESIGN  Structural design and component tests of large
Telerobotic work system: Concept development and evolution p 104 N87-29864 Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867  ROBOTS Robots on the Space Station p 100 A87-40844 Control of robot manipulator compliance p 100 A87-45797 The astronaut and the robot - Short- and long-term scenarios for space technology p 101 A87-53991 Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-22231 Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233 Telerobotic technology for nuclear and space applications [NASA-CR-180923] p 102 N87-22242 Self-calibration strategies for robot manipulators p 102 N87-26355	High speed simulation of multi-flexible-body systems with large rotations [AIAA PAPER 87-0930] p 57 A87-33730 Experiences of CNES and SEP on space mechanisms rotating at low speed p 104 N87-29868 ROTATION SHAFTS Common drive unit p 104 N87-29869 ROTATION Suboptimal control of large flexible space structures experiencing rotational dynamics nonlinearities [AD-A180606] p 71 N87-25352 ROTOR BLADES (TURBOMACHINERY) The effect of circumferential aerodynamic detuning on coupled bending-torsion unstalled supersonic flutter [ASME PAPER 86-GT-100] p 166 A87-25396  SAFETY 20 kHz Space Station power system	[LP-RP-Al-204-VOL-1] p 70 N87-24514  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Sampled nonlinear control for large angle maneuvers of flexible spacecraft  SATELLITE COMMUNICATION  Communication missions for geostationary platforms p 84 A87-34797  Japan's space development communications - An overview p 152 A87-43156  An advanced geostationary communications platform p 125 A87-43165  Japanese data relay satellite system  [AIAA PAPER 87-2199] p 154 A87-48585  SATELLITE CONTROL  Tethered satellite program control strategy  [AAS PAPER 86-221] p 123 A87-38570  A new concept of generalized structural filtering for active vibration control synthesis  [AIAA PAPER 87-2456] p 24 A87-50502  SATELLITE DESIGN  Structural design and component tests of large geostationary satellite bus p 144 A87-32335
Telerobotic work system: Concept development and evolution p 104 N87-29866 Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867  ROBOTS Robots on the Space Station p 100 A87-40844 Control of robot manipulator compliance p 100 A87-45797 The astronaut and the robot - Short- and long-term scenarios for space technology Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-2231 Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233 Telerobotic technology for nuclear and space applications [NASA-CR-180923] p 102 N87-22242 Self-calibration strategies for robot manipulators p 102 N87-26355 ROBUSTNESS (MATHEMATICS) Robust controller design using frequency domain	High speed simulation of multi-flexible-body systems with large rotations  [AIAA PAPER 87-0930] p 57 A87-33730  Experiences of CNES and SEP on space mechanisms rotating at low speed p 104 N87-29868  ROTATING SHAFTS  Common drive unit p 104 N87-29869  ROTATION  Suboptimal control of large flexible space structures experiencing rotational dynamics nonlinearities  [AD-A180606] p 71 N87-25352  ROTOR BLADES (TURBOMACHINERY)  The effect of circumferential aerodynamic detuning on coupled bending-torsion unstalled supersonic flutter  [ASME PAPER 86-GT-100] p 166 A87-25396  SAFETY  20 kHz Space Station power system  p 76 A87-40378  The results of a limited study of approaches to the	[LP-RP-Al-204-VOL-1] p 70 N87-24514  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  SATELLITE COMMUNICATION  Communication missions for geostationary platforms p 84 A87-34797  Japan's space development p 752 A87-34797  Japan's space development p 152 A87-43156  An advanced geostationary communications platform p 125 A87-43165  Japanese data relay satellite system  [AIAA PAPER 87-2199] p 154 A87-43165  SATELLITE CONTROL  Tethered satellite program control strategy  [AAS PAPER 86-221] p 123 A87-38570  A new concept of generalized structural filtering for active vibration control synthesis  [AIAA PAPER 87-2456] p 24 A87-50502  SATELLITE DESIGN  Structural design and component tests of large geostationary satellite bus p 144 A87-32335  Development of fluid loop system for spacecraft
Telerobotic work system: Concept development and evolution p 104 N87-29866  Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867  ROBOTS  Robots on the Space Station p 100 A87-40844 Control of robot manipulator compliance p 100 A87-45797  The astronaut and the robot - Short- and long-term scenarios for space technology p 101 A87-53991 Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-22231  Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233  Telerobotic technology for nuclear and space applications [NASA-CR-180923] p 102 N87-22242  Self-calibration strategies for robot manipulators p 102 N87-26355  ROBUSTNESS (MATHEMATICS)  Robust controller design using frequency domain constraints	High speed simulation of multi-flexible-body systems with large rotations  [AIAA PAPER 87-0930] p 57 A87-33730  Experiences of CNES and SEP on space mechanisms rotating at low speed p 104 N87-29868  ROTATING SHAFTS  Common drive unit p 104 N87-29869  ROTATION  Suboptimal control of large flexible space structures experiencing rotational dynamics nonlinearities  [AD-A180606] p 71 N87-25352  ROTOR BLADES (TURBOMACHINERY)  The effect of circumferential aerodynamic detuning on coupled bending-torsion unstalled supersonic flutter  [ASME PAPER 86-GT-100] p 166 A87-25396  SAFETY  20 kHz Space Station power system  p 76 A87-40378  The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary	[LP-RP-Al-204-VOL-1] p 70 N87-24514  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  SATELLITE COMMUNICATION  Communications - An overview p 152 A87-34797  Japan's space development programs for communications - An overview p 152 A87-34796  An advanced geostationary communications platform p 125 A87-43165  Japanese data relay satellite system  [AIAA PAPER 87-2199] p 154 A87-48585  SATELLITE CONTROL  Tethered satellite program control strategy  [AAS PAPER 86-221] p 123 A87-38570  A new concept of generalized structural filtering for active vibration control synthesis  [AIAA PAPER 87-2456] p 24 A87-50502  SATELLITE DESIGN  Structural design and component tests of large geostationary satellite bus p 144 A87-32335  Development of fluid loop system for spacecraft p 144 A87-32370
Telerobotic work system: Concept development and evolution p 104 N87-29866 Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867 ROBOTS Robots on the Space Station p 100 A87-40844 Control of robot manipulator compliance p 100 A87-40844 Control of robot manipulator compliance p 100 A87-45797 The astronaut and the robot - Short- and long-term scenarios for space technology p 101 A87-53991 Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-22231 Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233 Telerobotic technology for nuclear and space applications [NASA-CR-180923] p 102 N87-22242 Self-calibration strategies for robot manipulators p 102 N87-26355  ROBUSTNESS (MATHEMATICS) Robust controller design using frequency domain constraints p 11 A87-32229 Robust controller synthesis for a large flexible space	High speed simulation of multi-flexible-body systems with large rotations  [AIAA PAPER 87-0930] p 57 A87-33730  Experiences of CNES and SEP on space mechanisms rotating at low speed p 104 N87-29868  ROTATION SHAFTS  Common drive unit p 104 N87-29869  ROTATION  Suboptimal control of large flexible space structures experiencing rotational dynamics nonlinearities  [AD-A180606] p 71 N87-25352  ROTOR BLADES (TURBOMACHINERY)  The effect of circumferential aerodynamic detuning on coupled bending-torsion unstalled supersonic flutter  [ASME PAPER 86-GT-100] p 166 A87-25396  S  SAFETY  20 kHz Space Station power system  p 76 A87-40378  The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary  [NASA-CR-178276] p 8 N87-21020	[LP-RP-Al-204-VOL-1] p 70 N87-24514  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  SATELLITE COMMUNICATION  Communication missions for geostationary platforms p 84 A87-34797  Japan's space development programs for communications - An overview p 152 A87-43156  An advanced geostationary communications platform p 125 A87-43165  Japanese data relay satellite system  [AIAA PAPER 87-2199] p 154 A87-48585  SATELLITE CONTROL  Tethered satellite program control strategy  [AAS PAPER 86-221] p 123 A87-38570  A new concept of generalized structural filtering for active vibration control synthesis  [AIAA PAPER 87-2456] p 24 A87-50502  SATELLITE DESIGN  Structural design and component tests of large geostationary satellite bus p 144 A87-32335  Development of fluid loop system for spacecraft p 144 A87-32370  Comparison of satellite support structure aluminum
Telerobotic work system: Concept development and evolution p 104 N87-29866 Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867  ROBOTS Robots on the Space Station p 100 A87-40844 Control of robot manipulator compliance p 100 A87-45797 The astronaut and the robot - Short- and long-term scenarios for space technology Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-2231 Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233 Telerobotic technology for nuclear and space applications [NASA-CR-180923] p 102 N87-22242 Self-calibration strategies for robot manipulators p 102 N87-26355  ROBUSTNESS (MATHEMATICS) Robust controller design using frequency domain constraints p 11 A87-32229 Robust controller synthesis for a large flexible space antenna p 84 A87-32235	High speed simulation of multi-flexible-body systems with large rotations  [AIAA PAPER 87-0930] p 57 A87-33730  Experiences of CNES and SEP on space mechanisms rotating at low speed p 104 N87-29868  ROTATING SHAFTS  Common drive unit p 104 N87-29869  ROTATION  Suboptimal control of large flexible space structures experiencing rotational dynamics nonlinearities  [AD-A180606] p 71 N87-25352  ROTOR BLADES (TURBOMACHINERY)  The effect of circumferential aerodynamic detuning on coupled bending-torsion unstalled supersonic flutter  [ASME PAPER 86-GT-100] p 166 A87-25396  SAFETY  20 kHz Space Station power system  p 76 A87-40378  The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA ICC space station. Executive summary  [NASA-CR-178276] p 8 N87-21020  SAFETY FACTORS	[LP-RP-Al-204-VOL-1] p 70 N87-24514 Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356 Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358 SATELLITE COMMUNICATION  Communication missions for geostationary platforms p 84 A87-34797 Japan's space development programs for communications - An overview p 152 A87-43156 An advanced geostationary communications platform p 125 A87-43165 Japanese data relay satellite system [AIAA PAPER 87-2199] p 154 A87-48585 SATELLITE CONTROL  Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570 A new concept of generalized structural filtering for active vibration control synthesis [AIAA PAPER 87-2456] p 24 A87-50502 SATELLITE DESIGN  Structural design and component tests of large geostationary satellite bus p 144 A87-32335 Development of fluid loop system for spacecraft p 144 A87-32370 Comparison of satellite support structure aluminum versus graphite epoxy
Telerobotic work system: Concept development and evolution p 104 N87-29866 Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulation in space p 104 N87-29867  ROBOTS Robots on the Space Station p 100 A87-40844 Control of robot manipulator compliance p 100 A87-45797 The astronaut and the robot - Short- and long-term scenarios for space technology Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-22231 Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233 Telerobotic technology for nuclear and space applications [NASA-CR-180923] p 102 N87-22242 Self-calibration strategies for robot manipulators p 102 N87-22425 ROBUSTNESS (MATHEMATICS) Robust controller design using frequency domain constraints p 11 A87-32229 Robust controller synthesis for a large flexible space antenna p 84 A87-32235 Integrated control/structure design and robustness	High speed simulation of multi-flexible-body systems with large rotations  [AIAA PAPER 87-0930] p 57 A87-33730  Experiences of CNES and SEP on space mechanisms rotating at low speed p 104 N87-29868  ROTATING SHAFTS  Common drive unit p 104 N87-29869  ROTATION  Suboptimal control of large flexible space structures experiencing rotational dynamics nonlinearities  [AD-A 180606] p 71 N87-25352  ROTOR BLADES (TURBOMACHINERY)  The effect of circumferential aerodynamic detuning on coupled bending-torsion unstalled supersonic flutter  [ASME PAPER 86-GT-100] p 166 A87-25396  SAFETY  20 kHz Space Station power system  p 76 A87-40378  The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary  [NASA-CR-178276] p 8 N87-21020  SAFETY FACTORS  Safety on the Space Station p 162 A87-35599	[LP-RP-Al-204-VOL-1] p 70 N87-24514  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  SATELLITE COMMUNICATION  Communication missions for geostationary platforms p 84 A87-34797  Japan's space development programs for communications - An overview p 152 A87-43156  An advanced geostationary communications platform p 125 A87-43165  Japanese data relay satellite system  [AIAA PAPER 87-2199] p 154 A87-48585  SATELLITE CONTROL  Tethered satellite program control strategy  [AAS PAPER 86-221] p 123 A87-38570  A new concept of generalized structural filtering for active vibration control synthesis  [AIAA PAPER 87-2456] p 24 A87-50502  SATELLITE DESIGN  Structural design and component tests of large geostationary satellite bus p 144 A87-32335  Development of fluid loop system for spacecraft p 144 A87-32370  Comparison of satellite support structure aluminum versus graphite epoxy  [SAWE PAPER 1692] p 20 A87-36279
Telerobotic work system: Concept development and evolution p 104 N87-29866 Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867 ROBOTS Robots on the Space Station p 100 A87-40844 Control of robot manipulator compliance p 100 A87-45797 The astronaut and the robot - Short- and long-term scenarios for space technology p 101 A87-53991 Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-22231 Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233 Telerobotic technology for nuclear and space applications [NASA-CR-180923] p 102 N87-22242 Self-calibration strategies for robot manipulators p 102 N87-26355  ROBUSTNESS (MATHEMATICS) Robust controller design using frequency domain constraints p 11 A87-32229 Robust controller synthesis for a large flexible space antenna p 84 A87-32235 Integrated control/structure design and robustness [SAE PAPER 861821]	High speed simulation of multi-flexible-body systems with large rotations  [AIAA PAPER 87-0930] p 57 A87-33730  Experiences of CNES and SEP on space mechanisms rotating at low speed p 104 N87-29868  ROTATION SHAFTS  Common drive unit p 104 N87-29869  ROTATION Suboptimal control of large flexible space structures experiencing rotational dynamics nonlinearities  [AD-A180606] p 71 N87-25352  ROTOR BLADES (TURBOMACHINERY)  The effect of circumferential aerodynamic detuning on coupled bending-torsion unstalled supersonic flutter  [ASME PAPER 86-GT-100] p 166 A87-25396  SAFETY  20 kHz Space Station power system  p 76 A87-40378  The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary  [NASA-CR-178276] p 8 N87-21020  SAFETY FACTORS  Safety on the Space Station p 162 A87-35599  Automated Subsystem Control for Life Support System	[LP-RP-Al-204-VOL-1] p 70 N87-24514 Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356 Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358 SATELLITE COMMUNICATION  Communication missions for geostationary platforms p 84 A87-34797 Japan's space development programs for communications - An overview p 152 A87-43156 An advanced geostationary communications platform p 125 A87-43165 Japanese data relay satellite system [AIAA PAPER 87-2199] p 154 A87-48585 SATELLITE CONTROL  Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570 A new concept of generalized structural filtering for active vibration control synthesis [AIAA PAPER 87-2456] p 24 A87-50502 SATELLITE DESIGN  Structural design and component tests of large geostationary satellite bus p 144 A87-32335 Development of fluid loop system for spacecraft p 144 A87-32370 Comparison of satellite support structure aluminum versus graphite epoxy
Telerobotic work system: Concept development and evolution p 104 N87-29866 Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867 ROBOTS Robots on the Space Station p 100 A87-40844 Control of robot manipulator compliance p 100 A87-40844 Control of robot manipulator compliance p 100 A87-45797 The astronaut and the robot - Short- and long-term scenarios for space technology p 101 A87-53991 Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-22231 Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233 Telerobotic technology for nuclear and space applications [NASA-CR-180923] p 102 N87-22242 Self-calibration strategies for robot manipulators	High speed simulation of multi-flexible-body systems with large rotations  [AIAA PAPER 87-0930] p 57 A87-33730  Experiences of CNES and SEP on space mechanisms rotating at low speed p 104 N87-29868  ROTATING SHAFTS  Common drive unit p 104 N87-29869  ROTATION  Suboptimal control of large flexible space structures experiencing rotational dynamics nonlinearities  [AD-A180606] p 71 N87-25352  ROTOR BLADES (TURBOMACHINERY)  The effect of circumferential aerodynamic detuning on coupled bending-torsion unstalled supersonic flutter  [ASME PAPER 86-GT-100] p 166 A87-25396  SAFETY  20 kHz Space Station power system  p 76 A87-40378  The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary  [NASA-CR-178276] p 8 N87-21020  SAFETY FACTORS  Safety on the Space Station p 162 A87-35599  Automated Subsystem Control for Life Support System (ASCLSS)	[LP-RP-Al-204-VOL-1] p 70 N87-24514  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  SATELLITE COMMUNICATION  Communication missions for geostationary platforms p 84 A87-34797  Japan's space development programs for communications - An overview p 152 A87-43156  An advanced geostationary communications platform p 125 A87-43165  Japanese data relay satellite system  [AIAA PAPER 87-2199] p 154 A87-43165  SATELLITE CONTROL  Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  A new concept of generalized structural filtering for active vibration control synthesis [AIAA PAPER 87-2456] p 24 A87-50502  SATELLITE DESIGN  Structural design and component tests of large geostationary satellite bus p 144 A87-32335  Development of fluid loop system for spacecraft p 144 A87-32370  Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279  Working group on Earth observation requirements for the Polar Orbiting Platform Elements of the International Space Station (the POPE Working Group)
Telerobotic work system: Concept development and evolution p 104 N87-29866 Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulation in space p 104 N87-29867  ROBOTS Robots on the Space Station p 100 A87-40844 Control of robot manipulator compliance p 100 A87-45797 The astronaut and the robot - Short- and long-term scenarios for space technology Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-22231 Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22232 Telerobotic technology for nuclear and space applications [NASA-CR-180923] p 102 N87-22242 Self-calibration strategies for robot manipulators p 102 N87-22425 ROBUSTNESS (MATHEMATICS) Robust controller design using frequency domain constraints p 11 A87-32229 Robust controller synthesis for a large flexible space antenna p 84 A87-32235 Integrated control/structure design and robustness [SAE PAPER 861821] p 6 A87-32657 Robustness optimization of structural and controller parameters	High speed simulation of multi-flexible-body systems with large rotations  [AIAA PAPER 87-0930] p 57 A87-33730  Experiences of CNES and SEP on space mechanisms rotating at low speed p 104 N87-29868  ROTATION SHAFTS  Common drive unit p 104 N87-29869  ROTATION Suboptimal control of large flexible space structures experiencing rotational dynamics nonlinearities  [AD-A180606] p 71 N87-25352  ROTOR BLADES (TURBOMACHINERY)  The effect of circumferential aerodynamic detuning on coupled bending-torsion unstalled supersonic flutter  [ASME PAPER 86-GT-100] p 166 A87-25396  SAFETY  20 kHz Space Station power system  p 76 A87-40378  The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary  [NASA-CR-178276] p 8 N87-21020  SAFETY FACTORS  Safety on the Space Station p 162 A87-35599  Automated Subsystem Control for Life Support System	[LP-RP-Al-204-VOL-1] p 70 N87-24514  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  SATELLITE COMMUNICATION  Communication missions for geostationary platforms p 84 A87-34797  Japan's space development p 75 A87-43156  An advanced geostationary communications platform p 125 A87-43165  Japanese data relay satellite system  [AlAA PAPER 87-2199] p 154 A87-43165  SATELLITE CONTROL  Tethered satellite program control strategy  [AAS PAPER 86-221] p 123 A87-38570  A new concept of generalized structural filtering for active vibration control synthesis  [AlAA PAPER 87-2456] p 24 A87-50502  SATELLITE DESIGN  Structural design and component tests of large geostationary satellite bus p 144 A87-32335  Development of fluid loop system for spacecraft p 144 A87-32370  Comparison of satellite support structure aluminum versus graphite epoxy  [SAWE PAPER 1692] p 20 A87-36279  Working group on Earth observation requirements for the Polar Orbiting Platform Elements of the International Space Station (the POPE Working Group)
Telerobotic work system: Concept development and evolution p 104 N87-29866 Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulation in space p 104 N87-29867  ROBOTS Robots on the Space Station p 100 A87-40844 Control of robot manipulator compliance p 100 A87-45797 The astronaut and the robot - Short- and long-term scenarios for space technology Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-2231 Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22231 Telerobotic technology for nuclear and space applications [NASA-CR-180923] p 102 N87-22242 Self-calibration strategies for robot manipulators p 102 N87-22422 Self-calibration strategies for robot manipulators ROBUSTNESS (MATHEMATICS) Robust controller design using frequency domain constraints p 11 A87-32229 Robust controller synthesis for a large flexible space antenna p 84 A87-32251 Integrated control/structure design and robustness [SAE PAPER 861821] p 6 A87-32657 Robustness optimization of structural and controller parameters	High speed simulation of multi-flexible-body systems with large rotations  [AIAA PAPER 87-0930] p 57 A87-33730  Experiences of CNES and SEP on space mechanisms rotating at low speed p 104 N87-29868  ROTATING SHAFTS  Common drive unit p 104 N87-29869  ROTATION  Suboptimal control of large flexible space structures experiencing rotational dynamics nonlinearities  [AD-A180606] p 71 N87-25352  ROTOR BLADES (TURBOMACHINERY)  The effect of circumferential aerodynamic detuning on coupled bending-torsion unstalled supersonic flutter  [ASME PAPER 86-GT-100] p 166 A87-25396  SAFETY  20 kHz Space Station power system  p 76 A87-40378  The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary  [NASA-CR-178276] p 8 N87-21020  SAFETY FACTORS  Safety on the Space Station p 162 A87-35599  Automated Subsystem Control for Life Support System (ASCLSS)  [NASA-CR-172003] p 53 N87-29117	[LP-RP-Al-204-VOL-1] p 70 N87-24514  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  SATELLITE COMMUNICATION  Communication missions for geostationary platforms p 84 A87-34797  Japan's space development programs for communications - An overview p 152 A87-43156  An advanced geostationary communications platform p 125 A87-43165  Japanese data relay satellite system  [AIAA PAPER 87-2199] p 154 A87-43165  SATELLITE CONTROL  Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  A new concept of generalized structural filtering for active vibration control synthesis [AIAA PAPER 87-2456] p 24 A87-50502  SATELLITE DESIGN  Structural design and component tests of large geostationary satellite bus p 144 A87-32335  Development of fluid loop system for spacecraft p 144 A87-32370  Comparison of satellite support structure aluminum versus graphite epoxy [SAWE PAPER 1692] p 20 A87-36279  Working group on Earth observation requirements for the Polar Orbiting Platform Elements of the International Space Station (the POPE Working Group)

Design and fabrication of Stretched Rohini Satellite-1	SCHEDULING	Integrated structural electromagnetic optimization of
solar array p 83 N87-29006	Space Shuttle flight rates and utilization	large space antenna reflectors
SATELLITE GROUND SUPPORT Satellite servicing logistics	p 1 A87-37963	[AIAA PAPER 87-0824] p 14 A87-33611
[SAE PAPER 861723] p 132 A87-32612	Integrated scheduling and resource management for Space Station Information System	Quasi-static shape adjustment of a 15 meter diameter
Space station data management system - A common	[AIAA PAPER 87-2213] p 119 A87-48597	space antenna
GSE test interface for systems testing and verification	Mission scheduling expert system and its space station	[AIAA PAPER 87-0869] p 15 A87-33633
D 112 A87-37294	applications	Shape control of the directional pattern in a
SATELLITE LIFETIME	[AIAA PAPER 87-2221] p 7 A87-48602	microwave-beam power transmission channel
Simulation of on-orbit satellite fragmentations	A comparison of scheduling algorithms for autonomous	p 148 A87-34345
SATELLITE NETWORKS p 140 N87-24515	management of the Space Station electric energy	Problems of mechanical system configuration control
Japanese space information system overview	system [AIAA PAPER 87-2467] p 77 A87-50511	p 149 A87-35877 A new concept of generalized structural filtering for
[AIAA PAPER 87-2191] p 153 A87-48579	[AIAA PAPER 87-2467] p 77 A87-50511 SCIENTIFIC SATELLITES	active vibration control synthesis
Japanese data relay satellite system	Space research - At a crossroads	[AIAA PAPER 87-2456] p 24 A87-50502
[AIAA PAPER 87-2199] p 154 A87-48585	p 166 A87-32017	An Al-based model-adaptive approach to flexible
SATELLITE OBSERVATION	The tethered satellite system for low density	structure control
Conceptual design of the High-Resolution Imaging	aerothermodynamics studies p 127 A87-52450	[AIAA PAPER 87-2457] p 61 A87-50503
Spectrometer (HIRIS) for EOS p 126 A87-44185 Problems in merging Earth sensing satellite data sets	Thick dielectric charging on high altitude spacecraft	Distributed parameter modeling of the structural
[NASA-TM-87820] p 129 N87-22457	p 87 N87-26961 SEALS (STOPPERS)	dynamics of the Solar Array Flight Experiment
SATELLITE ORBITS	Quick-disconnect inflatable seal assembly	[AIAA PAPER 87-2460] p 25 A87-50506
Orbital modifications using forced tether-length	[NASA-CASE-KSC-11368-1] p 102 N87-25583	Tracking and pointing maneuvers with slew-excited
variations p 124 A87-40858	SECURITY	deformation shaping [AIAA PAPER 87-2599] p 62 A87-50561
Optimal shuttle altitude changes using tethers	Military space station implications	Dynamic modeling and optimal control design for large
[AD-A179205] p 129 N87-22756	[AD-A180831] p 172 N87-26964	flexible space structures p 26 N87-20358
SATELLITE POWER TRANSMISSION (TO EARTH)  The synthesis of the power transmission channel for a	SELF CONSISTENT FIELDS	OPUS: Optimal Projection for Uncertain Systems
satellite solar power station p 75 A87-35799	Potential surfaces for O atom-polymer reactions	[AD-A176820] p 29 N87-21025
SATELLITE SOLAR ENERGY CONVERSION	p 109 N87-26201 SELF ORGANIZING SYSTEMS	Large spacecraft pointing and shape control
Solar power satellites Russian book	Attitude control of a spacecraft using an extended	p 69 N87-24498
p 152 A87-44683	self-organizing fuzzy logic controller p 59 A87-41617	Shape design sensitivity analysis and optimal design of
Power plants in space p 155 A87-53560	SEMICONDUCTOR DEVICES	structural systems [NASA-CR-181095] n 37 N87-26370
SATELLITE SOLAR POWER STATIONS	On the control of structures by applied thermal	[NASA-CR-181095] p 37 N87-26370 An investigation of methodology for the control and
Shape control of the directional pattern in a	gradients p 33 N87-22747	failure identification of flexible structures
microwave-beam power transmission channel	Space station power semiconductor package	p 38 N87-26921
p 148 A87-34345 The synthesis of the power transmission channel for a	[NASA-CR-180829] p 81 N87-28825 SEMICONDUCTORS (MATERIALS)	Effect of bonding on the performance of a
satellite solar power station p 75 A87-35799	Testing of materials for solar power space	piezoactuator-based active control system
ATELLITE SURFACES	applications p 107 A87-53946	[NASA-CR-181414] p 74 N87-29713
Modeling of environmentally induced transients within	SENSITIVITY	Optimum shape control of flexible beams by
satellites	Sensitivity of distributed structures to model order in	piezo-electric actuators
[AIAA PAPER 85-0387] p 7 A87-41611	feedback control	[NASA-CR-181413] p 40 N87-29898 SHEAR STRESS
ATELLITE TRANSMISSION	[AIAA PAPER 87-0900] p 56 A87-33710	Effect of transverse shearing forces on buckling and
IKI department head on orbital power plants	Shape design sensitivity analysis and optimal design of	
p 158 N87-27693 ATELLITE-BORNE INSTRUMENTS	structural systems	compressive loads
An advanced wind scatterometer for the Columbus Polar	[NASA-CR-181095] p 37 N87-26370	[AIAA PAPER 87-0877] p 105 A87-33639
Platform payload p 155 A87-53117	Computational procedures for evaluating the sensitivity derivatives of vibration frequencies and Eigenmodes of	SHOCK ABSORBERS
Panel report on multidisciplinary instrumentation: New	framed structures	Analytical determination of space station response to
possibilities Columbus space station	[NASA-CR-4099] p 40 N87-29899	crew motion and design of suspension system for
p 161 N87-20637	SENSORS	microgravity experiments p 67 N87-22752
Planning for future operational sensors and other	Fiber-optic monitors for space structures	SHOCK LAYERS
priorities	p 11 A87-31505	A preliminary study of extended magnetic field structures in the ionosphere
[NOAA-NESDIS-30] p 130 N87-25560	Optimal placement of excitations and sensors for	[NASA-CR-181004] p 140 N87-23066
Summary of recent SAR instrument studies p 159 N87-27865	verification of large dynamical systems	SHOCK TESTS
Rendezvous and docking (RVD) long range RF sensor	[AIAA PAPER 87-0782] p 19 A87-33755 SERVICE LIFE	The Shock and Vibration Bulletin. Part 1: Welcome,
definition study, executive summary	An overview of photovoltaic applications in space	Invited Papers, Shipboard Shock, Blast and Ground Shock.
[SES/ENG/ES-519/86] p 138 N87-28588	p 80 N87-26414	Shock Testing and Analysis
ATELLITE-BORNE RADAR	Stopping differential charging of solar arrays	[AD-A175224] p 29 N87-20574
Nuclear reactor power for a space-based radar. SP-100	p 83 N87-28984	SHORT CIRCUITS
project	An electromechanical attenuator/actuator for Space	Permanent-magnet linear alternators. 1 - Fundamental equations. II - Design guidelines p 76 A87-39735
[NASA-TM-89295] p 79 N87-25838 ATELLITE-TO-SATELLITE TRACKING	Station docking p 138 N87-29878	MARECS and ECS anomalies: Attempt at insulation
Rendezvous and docking (RVD) long range RF sensor	Space Station lubrication considerations	defect production in Kapton p 82 N87-28980
definition study, executive summary	P 104 N87-29879 SERVICE MODULES	Micrometeorite impact on solar panels ESA
[SES/ENG/ES-519/86] p 138 N87-28588	End effector development study. Volume 2: Service End	telecommunication satellites p 82 N87-28981
CALE MODELS	Effector subsystem specification (SEESSPEC)	Micrometeorite exposure of solar arrays
Considerations in the design and development of a	in-orbiting servicing	p 82 N87-28982 SHUTTLE ENGINEERING SIMULATOR
space station scale model p 9 N87-22711	[FOK-TR-R-86-091-VOL-2] p 102 N87-24486	Flandete and the state of the s
The use of multidimensional scaling for facilities layout	End effector development study, volume 1 in-orbit	SIGNAL PROCESSING
- An application to the design of the Space Station	servicing	A VHSIC general purpose processor
p 118 A87-33003	[FOK-TR-R-86-091-VOL-1] p 102 N87-25336	p 116 N87-29145
On-orbit cryogenic fluid management experimental data	End effector development study. Volume 3: Appendices	Oxygen interaction with space-power materials
requirements using referee fluids	in-orbit servicing [FOK-TR-R-86-091-VOL-3] p 102 N87-25337	[NASA-CR-181396] p 132 N87-29633
[AIAA PAPER 87-1559] p 90 A87-44832	P 102 N87-25337 SERVOCONTROL	SILICON CARBIDES
Verification of large beam-type space structures	Control of robot manipulator compliance	Development of metal matrix composites in R & D
P 31 N87-22712	p 100 A87-45797	Institute of Metals & Composites for Future Industries
COFS 3 multibody dynamics and control technology	Control of multiple-mirror/flexible-structures in slew	SILICONE RESINS p 107 A87-51772
p 69 N87-24506 Preliminary design, analysis, and costing of a dynamic	maneuvers	Space stable thermal control coatings
scale model of the NASA space station	[AIAA PAPER 87-2324] p 24 A87-50445	[AD-A182796] p 110 N87-28584
NASA-CR-4068] p 36 N87-25606	Theory and application of linear servo dampers for large	SILOXANES
ATHA SATELLITE	scale space structures p 72 N87-26970	Aromatic polyester polysiloxane block copolymers:
Potential modulation on the SCATHA spacecraft	SERVOMECHANISMS	Multiphase transparent damping materials
p 138 A87-34460	Application of a traction-drive 7-degrees-of-freedom	[AD-A182623] p 110 N87-27809 SIMULATION
Investigation of beam-plasma interactions	telerobot to space manipulation	
NASA-CR-180579] p 129 N87-22508 ATTEROMETERS	[DE87-004616] p 101 N87-22231	Air Force basic research in dynamics and control of large space structures p 63 N87-20577
Observation of precipitation from space by the weather		
	SHAKERS	Control of flexible structures and the records
	Spacecraft qualification using advanced vibration and	Control of flexible structures and the research
adar p 145 A87-32507	Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20368	Control of flexible structures and the research
An advanced wind scatterometer for the Columbus Polar p 155 A87-33117	Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20368 SHAPE CONTROL	Control of flexible structures and the research community p 66 N87-22732 Large space structures testing [NASA-TM-100306] p 35 N87-24520
An advanced wind scatterometer for the Columbus Polar	Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20368	Control of flexible structures and the research community p 66 N87-22732 Large space structures testing

## SIMULATORS

	Solar array flight dynamic experiment	Optimization of heat rejection subsystem for solar
SIMULATORS  Track and capture of the orbiter with the space station	p 78 N87-22/22	dynamic Brayton cycle power system
Track and capture of the orbiter with the space station	Space station WP-04 power system. Volume 1:	[SAE PAPER 860999] p 43 A87-38776
remote manipulator system  [NASA-TM-89221] p 137 N87-25339	Evecutive summary	Survey of solar-dynamic space power - The Stirling
[NASA-TM-89221] p 137 N67-25559 SINGLE STAGE TO ORBIT VEHICLES	(NASA-CR-179587-VOL-1) p 78 N87-23695	
The single-stage reusable ballistic launcher concept for	Space station WP-04 power system. Volume 2: Study	option p // A07-42203 A transient analysis of phase change energy storage
aconomic cargo transportation p 135 A87-41573	regults	system for solar dynamic power
	(NASA-CR-179587-VOL-2) p 79 N87-23696	TATA DADED 87-14691 D 77 A87-43004
SINGULARITY (MATHEMATICS)  A study on singularity of single gimbal CMG systems	Advanced photovoltaic solar array design assessment	Solar array flight experiment/dynamic augmentation
p 149 A87-35077	p 80 N87-20429	experiment
•	High power/large area PV systems	TNIASA_TD_26901 p 63 N87-20380
SIZE (DIMENSIONS)  Expected size of a crater resulting from the impact of	D 80 N87-20432	Microgravity fluid management requirements of
a micrometeorite p 119 A87-41870	Computer modeling of high-voltage solar array	advanced solar dynamic power systems
CI EWING	avaginent using the NASCAP/LEO (NASA Charging	p 77 N87-21153
Effects of atmosphere on slewing control of a flexible	Analyzer Program/Low Earth Orbit) computer code	Structural concepts for large solar concentrators
etaucture D 22 A87-47809	[AD-A182589] p 81 N87-28186	[NASA_CR_4075] D 65 N87-21994
Control of multiple-mirror/flexible-structures in slew	Proceedings of the Fifth European Symposium on	Selection of high temperature thermal energy storage
manalivers	Photovoltaic Generators in Space	materials for advanced solar dynamic space power
(ALAA DADED 87-2324) D 24 A87-50445	[ESA-SP-267] P 81 N87-26959	evetoms
Tracking and pointing maneuvers with slew-excited	AMOC: An alternative module configuration for	(NASA-TM-898861 D 78 N87-22174
deformation shaping	advanced solar arrays in low Earth orbits p 159 N87-28968	Speculations on future opportunities to evolve Brayton
TAIAA PAPER 87-25991 p 62 A87-50561		powerplants aboard the space station
Slewing control experiment for a flexible panel	The high performance solar array GSR3 p 81 N87-28972	[NIASA-TM-89863] D 121 N87-23074
p /8 N8/-22/40	EURECA application of the Retractable Advanced Rigid	Space station WP-04 power system. Volume 1:
Slew maneuvers on the SCOLE Laboratory Facility	Array (RABA) solar array p 82 N87-28973	Executive summary
p 69 1487-24311	Array (RARA) solar array p 82 N87-28973 Improved solar generator technology for the EURECA	[NASA-CR-179587-VOL-1] p 78 N87-23695
Research in slewing and tracking control		Space station WP-04 power system. Volume 2: Study
p /U N87-24512	low Earth orbit p 159 Not-20074 The INMARSAT solar array: The first Advanced Rigid	results
Suboptimal control of large flexible space structures	Array (ARA) to fly p 82 N87-28975	[NASA-CR-179587-VOL-2] p 79 N87-23696
experiencing rotational dynamics nonlinearities	Array (ARA) to fly p 82 N87-26975  High power solar array technologies Columbus space	Space station electrical power system (NASA-TM-100140) p 80 N87-26144
[AD A180606] D /1 N87-2002		[14/0/-14/-100140]
Minimum time attitude slewing maneuvers of a rigid	GoAs concentrator solar arrays p 82 N87-28977	
spacecraft (NASA-CR-181130) p 72 N87-26038	The Cokker Stronghack solar array D 82 N87-28979	Status of space station power system p 84 N87-29915
[MAGA GA ASTRON	MARECS and ECS anomalies: Attempt at insulation	
SLOT ANTENNAS	defect production in Kapton D 82 N87-28980	SOLAR ELECTRIC PROPULSION  Advanced photovoltaic solar array design assessment
Carbon fibre slotted waveguide arrays p 85 A87-41302	Micrometeorite impact on solar panels ESA	p 80 N87-26429
·	telecommunication satellites p 82 N87-28981	SOLAR ENERGY CONVERSION
SOFTWARE ENGINEERING ESA software engineering standards for future	Micrometeorite exposure of solar arrays	Advanced photovoltaic solar array design assessment
	p 82 N87-28982	p 80 N87-26429
programmes [AIAA PAPER 87-2207] p 154 A87-48592	Stopping differential charging of solar arrays p 83 N87-28984	Alternative power generation concepts for space
Automated software production	SPOT solar array in-orbit deployment results	p 81 N87-28961
[AIAA PAPER 87-2219] p 2 A87-48601		SOLAR FLUX
Space operations: NASA's use of information	evaluation p 63 1467-25500 Aerospatiale solar arrays, in orbit performance	SPOT/MEGS design and flight results obtained solar prove (MEGS) p 103 N87-29009
technology. Report to the Chairman, Committee on	p 159 N87-28988	allay diffe (MEGG)
Science, Space and Technology	Computer simulation of deployment solar arrays	SOLAR GENERATORS Power plants in space p 155 A87-53560
[GAO/IMTEC-87-20] p 13/ N8/-22551 SAGA: A project to automate the management of	p 10 N87-29002	Performance characteristics of a combination solar
eoftware production systems	Thermal-electrical dynamical simulation of spacecraft	photovoltaic heat engine energy converter
[NASA_CR_180276] D 10 N87-27412	solar array p 83 N87-29004	[NASA-TM-89908] p 78 N87-23028
Proceedings: Computer Science and Data Systems	Design and fabrication of Stretched Rohini Satellite-1	IKI department head on orbital power plants
Technical Symposium, volume 1	SPOT/MEGS design and flight results obtained - solar	p 158 N87-27693
[NASA-TM-89285] p 116 N87-29124	array drive (MEGS) p 103 N87-29009	Organic Rankine cycle power conversion systems for p 159 N87-28989
A workstation environment for software engineering p 116 N87-29128	Test results from the solar array flight experiment	
Proceedings: Computer Science and Data Systems	p 83 N87-29010	SOLAR MAXIMUM MISSION Degradation studies of SMRM teflon
Proceedings: Computer Science and Data Systems	The extendable and retractable mast as supporting tool	p 106 A87-38641
Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144	for rigid colar arrays D 39 N87-29012	SOLAR OPTICAL TELESCOPE
[NASA-TM-89286] p 116 N87-29144 Testing and analysis of DOD Ada language products	Experiences of CNES and SEP on space mechanisms	SOT: A rapid prototype using TAE windows
	rotating at low speed p 104 N87-29868	p 114 N87-23161
for NASA p 172 N87-29133 KSC Space Station Operations Language (SSOL)	COLAD AUXII IARY POWER UNITS	SOLAR ORRITS
p 138 N87-29168	Preliminary analysis of a prototype space solar power	Choice of the optimal angular position of a spacecraft
SOFTWARE TOOLS	system (U.R.MITT-168) p 79 N87-24532	in the constant-solar-orientation flight segment
Event evetems in space D 111 A87-320/5	[12/1-14/17 1-100]	p 148 A87-34207
TAE Plus: A conceptual view of TAE in the space station	SOLAR CELLS Frequency dispersion in the admittance of the	SOLAR POWER SATELLITES
079 PM 107-23137	polycrystalline Cu2S/CdS solar cell p 5 A87-29133	Choice of the optimal angular position of a spacecraft
SAGA: A project to automate the management of	Testing of materials for solar power space	in the constant-solar-orientation flight segment p 148 A87-34207
software production systems		p 146 A67-34207
[NASA-CR-180276] p 10 N87-27412	applications p 107 A87-3346 An overview of photovoltaic applications in space	The synthesis of the power transmission channel for a
Advanced software tools space station focused	p 80 N87-26414	
	Design study of large area 8 cm x 8 cm wrapthrough	Solar power satellites Russian book p 152 A87-44683
KSC Space Station Operations Language (SSOL) p 138 N87-29168	cells for space station D 80 N87-20424	
•	Computer modeling of high-voltage solar array	Power plants in space p 155 A87-53560 Testing of materials for solar power space
SOLAR ARRAYS  Laboratory simulation of plasma interaction with high	evperiment using the NASCAP/LEO (NASA Charging	applications p 107 A87-53946
unitago colar array D 145 A67-32300	Analyzer Program/Low Earth Orbit) computer code	Preliminary analysis of a prototype space solar power
Elevibility control of torsional vibrations of a large solar	[AD-A182589] p 81 N87-28186	evetem
p 12 A87-32442	Proceedings of the Fifth European Symposium on	(II D.MITT-168) p 79 N87-24532
Control of flexible solar arrays with consideration of the	Photovoltaic Generators in Space	Technology for Large Space Systems. A bibliography
actuator dynamics of the reaction wheel	[ESA-SP-267] p 81 No7-26939 AMOC: An alternative module configuration for	with indexes (supplement 17)
p 55 A87-32440	advanced solar arrays in low Earth orbits	[NASA-SP-7046(17)] p 39 N87-29576
Solar array flight dynamic experiment	p 159 N87-28968	SOLAR PROPULSION
[AAS PAPER 86-050] p 75 A67-32747 Composite tubes for the Space Station truss structure	Improved solar generator technology for the EURECA	A two-dimensional numerical heat transfer model for a solar propulsion system p 74 A87-32306
Composite tubes for the Space Station truss statetard p 20 A87-38601	low Farth orbit p 159 N87-28974	solar propulsion system p 74 A87-32306 Testing of materials for solar power space
Distributed parameter modeling of the structural	GaAs concentrator solar arrays D 82 N87-289//	
dynamics of the Solar Array Flight Experiment	Advanced Solar GaAs Array (ASGA) experiment on	COLAR RADIATION
(ALAA DADED 97-9460) 0.25 A87-90500	FURECA: Flight objectives and instrument configuration	Enhancement of solar absorptance degradation due to
Modal testing of the Olympus development model	p 83 N87-28965	contamination of solar radiator panels in geosynchronous
atoward solar array D 27 N87-20300	Absolute indoor calibration of large area solar cells	orbit - Correlation of flight data and laboratory
Acquistic effects on the dynamic of lightweight	p 159 N87-29015	measurements p 144 A87-32346
etructure p 28 N87-20372	Solar concentrator system for experiments in the Space	SOLAR RADIATION SHIELDING
Solar array flight experiment/dynamic augmentation	Station p 146 A87-32535	Radiation shielding requirements on long-duration space
experiment (NASA-TP-26901 p.63 N87-20380	Structural concepts for large solar concentrators	missions - 440 NR7 21001
[14707-11-2000]	[NASA-CR-4075] p 65 N87-21994	[AD-A177512] p 140 N87-21991
SAFE/DAE: Modal test in space p 77 N87-20584		

SAFE/DAE: Modal test in space p 77 N87-20584

SOLAR SAILS		
Space Station options for constructing advanced solar	Variable energy, high flux, ground-state atomic oxygen source	Optimizing experimental programs in operational
sails capable of multiple Mars missions	[NASA-CASE-NPO-16640-1-CU] p 8 N87-21661	planning of research carried out from spacecraft
[AIAA PAPER 87-1902] p 91 A87-45287	Proceedings of the NASA Workshop on Atomic Oxygen	p 160 N87-29553 SPACE FLIGHT FEEDING
SOLAR SENSORS	Effects low earth orbital environment	Foods and nutrition in space
Space Station alpha joint bearing p 83 N87-29882 SOLAR SIMULATORS	[NASA-CR-181163] p 141 N87-26173	[SAE PAPER 860926] p 47 A87-38716
Infrared test technique validation on the Olympus	High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p 141 N87-26186	Space Station Food System
satellite	Neutral atomic oxygen beam produced by ion charge	[SAE PAPER 860930] p 48 A87-38720
[SAE PAPER 860939] p 150 A87-38728	exchange for Low Earth Orbital (LEO) simulation	Space Station galley design [SAE PAPER 860932] p 119 A87-38722
SOLAR TERRESTRIAL INTERACTIONS	p 131 N87-26188	[SAE PAPER 860932] p 119 A87-38722 SPACE FLIGHT STRESS
Design considerations for long-lived glass mirrors for space p 123 A87-36531	Pulsed source of energetic atomic oxygen p 108 N87-26189	Physiological aspects of EVA
SOLAR THERMAL PROPULSION	NASA Marshall Space Flight Center atomic oxygen	[SAE PAPER 860991] p 164 A87-38768
Advanced propulsion activities in the USA	investigations p 109 N87-26202	Evaluation of physical work capacity of cosmonauts
p 90 A87-41575	Martin Marietta atomic oxygen Low Earth Orbit (LEO)	aboard Salyut-6 station p 157 N87-20735
SOLID MECHANICS	simulation p 142 N87-26204 Micrometeorite exposure of solar arrays	SPACE FLIGHT TRAINING
Studies in nonlinear structural dynamics: Chaotic	p 82 N87-28982	The undersea habitat as a space station analog: Evaluation of research and training potential
behavior and poynting effect p 26 N87-20348 SOLID WASTES	SPACE ERECTABLE STRUCTURES	[NASA-CR-180342] p 53 N87-27405
An improved waste collection system for space flight	Structure and function of Deployable Truss Beam	SPACE HABITATS
[SAE PAPER 861014] p 119 A87-38784	(DTB) p 12 A87-32548	Habitation module for the Space Station
SOUND TRANSMISSION	The Mast Flight System dynamic characteristics and actuator/sensor selection and location	[SAE PAPER 860928] p 163 A87-38718
Vibrations and structureborne noise in space station	[AAS PAPER 86-003] p 13 A87-32729	Habitability issues for the Science Laboratory Module [SAE PAPER 860971] p 50 A87-38753
[NASA-CR-181381] p 39 N87-29590	New concepts of deployable truss units for large space	[SAE PAPER 860971] p 50 A87-38753 Space station: A program overview
SOVIET SPACECRAFT	structures	p 171 N87-24496
Advances by the Soviet Union in space cooperation and commercial marketing made 1986 a landmark year	[AIAA PAPER 87-0868] p 14 A87-33632	SPACE INDUSTRIALIZATION
p 149 A87-34595	Nonlinear transient analysis of joint dominated structures	Tether power supplies exploiting the characteristics of
The Gagarin scientific lectures in astronautics and	[AIAA PAPER 87-0892] p 17 A87-33709	space [AAS PAPER 86-227] p 123 A87-38571
aviation. 1985 Russian book p 152 A87-42923	Alternative methods to fold/deploy tetrahedral or	The Industrial Space Facility p 167 A87-38579
Mir - A second Sputnik? p 153 A87-46872 SOYUZ SPACECRAFT	pentahedral truss platforms p 19 A87-34467	The industrial use of Spacelab p 168 A87-40286
Gravity-gradient stabilization of the Salyut 6-Soyuz	Thermal design of the ACCESS erectable space truss	Solar power satellites Russian book
orbital complex p 147 A87-32801	p 42 A87-34469 Large space antennas: A systems analysis case	p 152 A87-44683
SPACE ADAPTATION SYNDROME	history	SPACE INFRARED TELESCOPE FACILITY
Space motion sickness status report	[NASA-TM-89072] p 26 N87-20352	Space Infrared Telescope Facility/Multimission Modular Spacecraft Attitude Control System conceptual design
[SAE PAPER 860923] p 163 A87-38714 SPACE BASED RADAR	Solar array flight experiment/dynamic augmentation	[AAS PAPER 86-031] p 56 A87-32736
Observation of precipitation from space by the weather	experiment [NASA-TP-2690] p. 63 N87-20380	SPACE LABORATORIES
radar p 145 A87-32507	[NASA-1P-2690] p 63 N87-20380 Status of the Mast experiment p 30 N87-22703	Special considerations in outfitting a space station
Nuclear reactor power for a space-based radar. SP-100	Design, construction, and utilization of a space station	module for scientific use [SAE PAPER 860956] p 164 A87-38741
project	assembled from 5-meter erectable struts	[SAE PAPER 860956] p 164 A87-38741 Science Research Facilities - Versatility for Space
[NASA-TM-89295] p 79 N87-25838 SPACE CHARGE	p 34 N87-24501	Station
The Aerospace Environment at High Altitudes and its	COFS 3 multibody dynamics and control technology	[SAE PAPER 860958] p 119 A87-38742
Implications for Spacecraft Charging and	p 69 N87-24506 Antenna Technology Shuttle Experiment (ATSE)	Habitability issues for the Science Laboratory Module
Communications	p 87 N87-24508	[SAE PAPER 860971] p 50 A87-38753
[AGARD-CP-406] p 142 N87-26937	Bi-stem gripping apparatus	Life Science Research Facility materials management requirements and concepts
Thick dielectric charging on high altitude spacecraft	[NASA-CASE-MFS-28185-1] p 107 N87-25586	[SAE PAPER 860974] p 124 A87-38756
p 87 N87-26961 SPACE COLONIES	Space station systems: A bibliography with indexes (supplement 4)	Plant and animal accommodation for Space Station
Space colonization - T minus 20 (years) and holding	[NASA-SP-7056(04)] p 4 N87-26073	Laboratory
p 166 A87-32286	Remote handling facility and equipment used for space	[SAE PAPER 860975] p 124 A87-38757 SPACE LAW
SPACE COMMERCIALIZATION	truss assembly	The station is raising lots of questions about space
Commercialization of space - The insurance implications p.166 ART-32460	[DE87-009121] p 103 N87-27408	law p 167 A87-34597
implications p 166 A87-32460 Space Station program in a long-range space	The 21st Aerospace Mechanisms Symposium [NASA-CP-2470] p 103 N87-29858	Legal problems concerning manned space flight
development scenario of Japan p 145 A87-32530	[NASA-CP-2470] p 103 N87-29858 Folding, articulated, square truss p 40 N87-29859	Hussian book p 151 A87-40339
Advances by the Soviet Union in space cooperation and	SPACE EXPLORATION	Present and future military uses of outer space: International law, politics, and the practice of states
commercial marketing made 1986 a landmark year	International cooperation in space	[AD-A176722] p 170 N87-21753
p 149 A87-34595 The SERVICE concept p 134 A87-36362	p 149 A87-34594	Space stations and the law: Selected legal issues
The European space programme p 150 A87-37962	A survey of tether applications to planetary exploration	[PB87-118220] p 171 N87-21754
Tether power supplies exploiting the characteristics of	[AAS PAPER 86-206] p 123 A87-38568	SPACE LOGISTICS Satellite servicing logistics
SPACE	Space the next twenty-five years Book p 168 A87-44375	[SAE PAPER 861723] p 132 A87-32612
[AAS PAPER 86-227] p 123 A87-38571 Symposium on Microgravity Fluid Mechanics,	Man's role in space exploration and exploitation	SPACE MAINTENANCE
Proceedings of the Winter Annual Meeting, Anaheim, CA,	p 169 A87-46332	Hubble Space Telescope satellite servicing
Dec. 7-12, 1986 p 89 A87-38785	Prospects for space science	[SAE PAPER 861796] p 133 A87-32644
Perspectives on materials processing in space	[AAS PAPER 86-106] p 170 A87-53085	User interface design guidelines for expert troubleshooting systems for Space Station
[AAS PAPER 86-103] p 170 A87-53083 Plans for industrialization of space discussed	Technology projections and space systems	p 6 A87-33050
p 157 N87-21979	opportunities for the 2000-2030 time period [AAS PAPER 86-109] p.2 A87-53086	Advanced orbital servicing capabilities development
SPACE COMMUNICATION	National Aeronautics and Space Administration	[SAE PAPER 860992] p 134 A87-38769
Development of a computer program to generate typical	Authorization Act, fiscal year 1988	Maintenance components for Space Station long life fluid systems
measurement values for various systems on a space	[H-REPT-100-204] p 171 N87-25024	[SAE PAPER 861005] p 89 A87-38778
station p 115 N87-26698 Technology for Large Space Systems. A bibliography	Military man in space: A history of Air Force efforts to	On-orbit assembly and repair p 135 A87-40376
with indexes (supplement 17)	find a manned space mission	Planning for space robotics developments and
[NASA-SP-7046(17)] p 39 N87-29576	[AD-A179873] p 171 N87-25815	applications p 135 A87-40377
SPACE DEBRIS	USSR Report: Space [JPRS-USP-86-004] p 158 N87-27687	Robots on the Space Station p 100 A87-40844 Concepts for space maintenance of OTV engines
A space debris simulation facility for spacecraft materials evaluation p. 11 A87-32058	National Aeronautics and Space Administration	p 135 A87-41161
orbital debris environment resulting from future activities	p 172 N87-30220	A proposal for space tether damage indication, location.
in space p 139 A87-44392	SPACE FLIGHT	and evaluation - The Repair Monkey Module
Space station integrated wall design and penetration	Superfluid helium on orbit transfer (SHOOT)	p 125 A87-43354
damage control	p 95 N87-21151	Servicing of the polar platform Columbus space station p. 136 N87-20628
[NASA-CR-179165] p 39 N87-28581	Two-phase reduced gravity experiments for a space	Developing a voice-controlled, computer-generated
SPACE ENVIRONMENT SIMULATION  Evaluation testing of a mechanical actuator component	reactor design p 8 N87-21154	display to assist space station astronauts during
operating in a simulated space environment	Toward the year 2000: The near future of the American civilian and military space programs	maintenance activity
p 160 A87-32549	[DE87-006467] p 171 N87-22697	[AD-A178997] p 120 N87-22762
Energy expenditure during simulated EVA workloads	Optimal nodal transfer and aeroassisted transfer by	A quantitative comparison of several orbital maneuvering
[SAE PAPER 860921] p 163 A87-38713	aerocruise p 138 N87-28577	vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677
	•	- pioi 140/-230//

# SPACE MANUFACTURING

		Convict tube array space transmission line
End effector development study. Volume 2: Service End	Development of control and monitor subsystem for	Coaxial tube array space transmission line characterization
Effector subsystem specification (SEESSPEC)	electric propulsion experiment onboard Space Flyer Unit	(NASA TM 80864) D 96 N87-22003
in-orbiting servicing	(SFU) [AIAA PAPER 87-1041] p 76 A87-39629	Speculations on future opportunities to evolve Brayton
[FOK-TR-R-86-091-VOL-2] p 102 N87-24486 End effector development study, volume 1 in-orbit	Communication and Data Management Systems for an	powerplants aboard the space station [NASA-TM-89863] p 121 N87-23674
	orbiting platform p 112 A87-40359	[NASA-TM-89863] p 121 N87-23674 SPACE POWER UNIT REACTORS
servicing [FOK-TR-R-86-091-VOL-1] p 102 N87-25336	A three-mass tethered system for micro-g/variable-g	Alternative power generation concepts for space
End effector development study. Volume 3: Appendices	applications p 125 A87-40859	p 81 N87-28961
in-orbit servicing	A polar platform for the remote sensing needs of ecology	SPACE PROCESSING
[FOK-TR-R-86-091-VOL-3] p 102 N87-25337	and agriculture - A view from the U.K. p 125 A87-41430	Contribution of the German Democratic Republic (East Germany) to the 'Intercosmos' program of study of
Concepts for space maintenance of OTV engines p 137 N87-26097	The evolution of the geostationary platform concept	materials in space aboard the orbiting station Salyut 6
Space Station Jubrication considerations	p 125 A87-43154	p 147 A87-32814
p 104 N87-29879	An advanced geostationary communications platform	Non-intrusive techniques for thermal measurements in
Space Station alpha joint bearing p 83 N87-29882	p 125 A87-43165	microgravity fluid science experiments
SPACE MANUFACTURING	Earth resources instrumentation for the Space Station	p 151 A87-39836
The mechanics of manufacturing in space p 167 A87-40068	Polar Platform p 126 A87-44184	The mechanics of manufacturing in space p 167 A87-40068
Process control and data acquisition for commercial	The Earth Observing System (EOS) synthetic aperture	Process control and data acquisition for commercial
materials processing in space	Tadar (Criti)	materials processing in space
(AIAA PAPER 87-2197) p 113 A87-48583	A cost effective 300 Mbps space-to-ground communications subsystem for the Space Station	[AIAA PAPER 87-2197] p 113 A87-48583
Development of a small-sized space manipulator p 101 A87-51979	program D 113 A87-45321	Perspectives on materials processing in space [AAS PAPER 86-103] p 170 A87-53083
Progress on the Ohio State University Get Away Special	The dynamics and control of the Space Station polar	[AAS PAPER 86-103] p 170 A67-53063 Microgravity experiments onboard Eureca
G-0318: DEAP p 170 N87-20311	platform	p 155 A87-53554
Plans for industrialization of space discussed	[AIAA PAPER 87-2600] p 62 A87-50562	Plans for industrialization of space discussed
p 157 N87-21979	Microgravity experiments onboard Eureca p 155 A87-53554	p 157 N87-21979
Active vibration control in microgravity environment p 72 N87-26700	Proceedings of the European Symposium on Polar	Active vibration control in microgravity environment p 72 N87-26700
·	platform Opportunities and Instrumentation for	Progress in theory, technology of space margerals
SPACE MISSIONS Space research - At a crossroads	Remote-Sensing (ESPOIR)	
p 166 A87-32017	rega_sp_ses) p 128 N87-20621	SPACE PROGRAMS
Technology projections and space systems	The Earth observation activities of the European Space	International Symposium on Space Technology and
conortunities for the 2000-2030 time period	Agency and the use of the polar platform of the	Science, 15th, Tokyo, Japan, May 19-23, 1986,
[AAS PAPER 86-109] P 2 A87-53086	International Space Station p 128 N87-20622 Working group on Earth observation requirements for	Proceedings Volumes 1 & 2 D 166 A87-32279
Space 2000 in Europe p 159 N87-29024 LEO and GEO missions p 5 N87-29916	the Polar Orbiting Platform Elements of the International	EASCON '86; Proceedings of the Nineteenth Annual Electronics and Aerospace Systems Conference,
LEO and GEO missions p 5 N87-29916  JPL future missions and energy storage technology	Space Station (the POPE Working Group)	Washington, DC, Sept. 8-10, 1986 p. 2 A87-40351
implications p 84 N87-29917	p 128 N87-20020	Space the next twenty-five years Book
CRACE NAVIGATION	ESA Columbus polar platform design concept p 156 N87-20627	D 168 A87-44375
Aeroassist flight experiment guidance, navigation and	Servicing of the polar platform Columbus space	Analysis and implementation of automation aspects in
control p 133 A87-32744	station p 136 N87-20628	the Columbus and Hermes end to end systems (ALAA PAPER 87-2210) p 154 A87-48595
[AAS PAPER 86-042] p 133 A87-32744  GPS applications to the Space Station	Orbit configurations space station polar platform	[AIAA PAPER 87-2210] p 154 A87-48595 The human quest in space; Proceedings of the
p 136 A87-45525	p 156 N87-20029	Twenty-fourth Goddard Memorial Symposium, Greenbelt,
SPACE OBSERVATIONS (FROM EARTH)	Payload data management scheme planned for Earth	MD, Mar. 20, 21, 1986 p 2 A87-53082
Infra-red astronomy after IRAS p 127 A87-54197	observation sensors to be flown on the polar platforms in the framework of the space station/Columbus	Prospects for space science
CDACE DI ASMAS		[AAS PAPER 86-106] p 170 A87-53085
Hollow cathode-based plasma contactor experiments for	Cooperation of the International Space Station partners	Technology projections and space systems
electrodynamic tether [AIAA PAPER 87-0572] p 121 A87-32192	in the preparation of the use of space station elements	opportunities for the 2000-2030 time period [AAS PAPER 86-109] p 2 A87-53086
Electrodynamic plasma motor/generator experiment	for Earth observation (platform and payload aspects)	Human capabilities in space
(AAS DADED 86-210) D 89 A87-38569	p 128 N87-20631	[AAS PAPER 86-114] p 165 A87-53089
Theory of plasma contactors for electrodynamic tethered	USA-Europe coordination and cooperation activities: Announcements of Opportunity polar platforms	SPACE RATIONS
cotollite evetems D 85 A87-41009	p 170 N87-20632	Space Station Food System
Effects of space plasma discharge on the performance of large antenna structures in low Earth orbit	Report of the atmosphere panel p 161 N87-20633	[SAE FAFER GOODGO]
[NASA-TM-89118] p 86 N87-20339	Land panel report International Space Station	Space Station galley design [SAE PAPER 860932] p 119 A87-38722
A preliminary study of extended magnetic field structures	p 128 N87-20634	[OAL I'M LIT SEEDING
in the ionosphere	Ocean-ice panel report International Space Station p 156 N87-20635	SPACE RENDEZVOUS Mir in action p 150 A87-37971
[NASA-CR-181004] p 140 N87-23066	Solid Earth panel report Columbus program	Inadequacy of single-impulse transfers for path
Electron beam experiments at high altitudes	p 157 N87-20636	constrained rendezvous p 90 A87-41615
p 142 N87-26946		
	Panel report on multidisciplinary instrumentation: New	Control of an autonomous spacecraft rendezvous and
Automatic charge control system for geosynchronous	Panel report on multidisciplinary instrumentation: New possibilities Columbus space station	Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing
satellites p 87 N87-20900	possibilities Columbus space station p 161 N87-20637	Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156
satellites p 87 N87-20900  SPACE PLATFORMS	possibilities Columbus space station p 161 N87-20637 Data management panel report Columbus polar	Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 [Developing Space Station, II - Power, rendezvous,
satellites p 87 N87-26960  SPACE PLATFORMS  Expert systems in space p 111 A87-32075	possibilities Columbus space station p 161 N87-20637  Data management panel report Columbus polar p 114 N87-20639	Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Developing Space Station. II - Power, rendezvous, docking and remote sensing are important elements of
satellites p 87 N87-26960  SPACE PLATFORMS  Expert systems in space p 111 A87-32075  The Space Station - Work Package 3 p 118 A87-32529	possibilities Columbus space station p 161 N87-20637  Data management panel report Columbus polar platforms p 114 N87-20639 The orbit configuration panel report Columbus polar platforms p 157 N87-20640	Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Developing Space Station. II - Power, rendezvous, docking and remote sensing are important elements of the Space Station p 127 A87-54198
satellites p 87 N87-26960  SPACE PLATFORMS  Expert systems in space p 111 A87-32075  The Space Station - Work Package 3 p 118 A87-32529  Advanced technology experiment onboard space	possibilities Columbus space station p 161 N87-20637  Data management panel report Columbus polar platforms p 114 N87-20639  The orbit configuration panel report Columbus polar platforms p 157 N87-20640  Panel report on the polar platform servicing approach	Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Developing Space Station. II - Power, rendezvous, docking and remote sensing are important elements of the Space Station p 127 A87-54198 Rendezvous and docking (RVD) long range RF sensor
satellites p 87 N87-26960  SPACE PLATFORMS  Expert systems in space p 111 A87-32075  The Space Station - Work Package 3 p 118 A87-32529  Advanced technology experiment onboard space platform p 122 A87-32536	possibilities Columbus space station  p 161 N87-20637  Data management panel report Columbus polar platforms  The orbit configuration panel report Columbus polar platforms  Panel report on the polar platform servicing approach and its implications Columbus space station	Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Developing Space Station. II - Power, rendezvous, docking and remote sensing are important elements of the Space Station p 127 A87-54198 Rendezvous and docking (RVD) long range RF sensor definition study, executive summary
satellites p 87 N87-26960  SPACE PLATFORMS  Expert systems in space p 111 A87-32075  The Space Station - Work Package 3 p 118 A87-32529  Advanced technology experiment onboard space platform p 122 A87-32536  Design of a polar platform with an earth observation	possibilities Columbus space station p 161 N87-20637  Data management panel report Columbus polar platforms p 114 N87-20639 The orbit configuration panel report Columbus polar platforms p 157 N87-20640  Panel report on the polar platform servicing approach and its implications Columbus space station p 136 N87-20641	Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Developing Space Station. II - Power, rendezvous, docking and remote sensing are important elements of the Space Station p 127 A87-54198 Rendezvous and docking (RVD) long range RF sensor definition study, executive summary [SES/ENG/ES-519/86] p 138 N87-28588 SPACE SHITTLE MISSION 41-D
satellites p 87 N87-26960  SPACE PLATFORMS  Expert systems in space p 111 A87-32075  The Space Station - Work Package 3 p 118 A87-32529  Advanced technology experiment onboard space platform p 122 A87-32536  Design of a polar platform with an earth observation payload p 122 A87-32538	possibilities Columbus space station p 161 N87-20637  Data management panel report Columbus polar platforms p 114 N87-20639 The orbit configuration panel report Columbus polar platforms p 157 N87-20640 Panel report on the polar platform servicing approach and its implications Columbus space station p 136 N87-20641  Research in slewing and tracking control	Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Developing Space Station. II - Power, rendezvous, docking and remote sensing are important elements of the Space Station p 127 A87-54198 Rendezvous and docking (RVD) long range RF sensor definition study, executive summary [SES/ENG/ES-519/86] p 138 N87-28588 SPACE SHUTTLE MISSION 41-D Test results from the solar array flight experiment
satellites p 87 N87-26960  SPACE PLATFORMS  Expert systems in space p 111 A87-32075  The Space Station - Work Package 3 p 118 A87-32529  Advanced technology experiment onboard space platform p 122 A87-32536  Design of a polar platform with an earth observation payload p 122 A87-32538  Concept design and cost estimation of a free-flying	possibilities Columbus space station p 161 N87-20637  Data management panel report Columbus polar platforms The orbit configuration panel report Columbus polar platforms Panel report on the polar platform servicing approach and its implications Columbus space station p 136 N87-20641  Research in slewing and tracking control p 70 N87-24512	Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Developing Space Station. II - Power, rendezvous, docking and remote sensing are important elements of the Space Station p 127 A87-54198 Rendezvous and docking (RVD) long range RF sensor definition study, executive summary [SES/ENG/ES-519/86] p 138 N87-28588 SPACE SHUTTLE MISSION 41-D Test results from the solar array flight experiment p 83 N87-29010
satellites p 87 N87-26960  SPACE PLATFORMS  Expert systems in space p 111 A87-32075  The Space Station - Work Package 3 p 118 A87-32529  Advanced technology experiment onboard space platform p 122 A87-32536  Design of a polar platform with an earth observation payload p 122 A87-32538  Concept design and cost estimation of a free-flying space platform p 146 A87-32539	possibilities Columbus space station p 161 N87-20637  Data management panel report Columbus polar platforms p 114 N87-20639 The orbit configuration panel report Columbus polar platforms p 157 N87-20640 Panel report on the polar platform servicing approach and its implications Columbus space station p 136 N87-20641  Research in slewing and tracking control p 70 N87-24512  Space station systems: A bibliography with indexes (supplement 4)	Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Developing Space Station. II - Power, rendezvous, docking and remote sensing are important elements of the Space Station p 127 A87-54198 Rendezvous and docking (RVD) long range RF sensor definition study, executive summary [SES/ENG/ES-519/86] p 138 N87-28588 SPACE SHUTTLE MISSION 41-D Test results from the solar array flight experiment p 83 N87-29010
satellites p 87 N87-26960  SPACE PLATFORMS  Expert systems in space p 111 A87-32075  The Space Station - Work Package 3 p 118 A87-32529  Advanced technology experiment onboard space platform p 122 A87-32536  Design of a polar platform with an earth observation payload p 122 A87-32536  Concept design and cost estimation of a free-flying space platform p 146 A87-32539  On-orbit fluid management p 132 A87-32538	possibilities Columbus space station p 161 N87-20637  Data management panel report Columbus polar platforms p 114 N87-20639 The orbit configuration panel report Columbus polar platforms p 157 N87-20640 Panel report on the polar platform servicing approach and its implications Columbus space station p 136 N87-20641 Research in slewing and tracking control p 70 N87-24512 Space station systems: A bibliography with indexes (supplement 4) [N87-256(041)] p 4 N87-26073	Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Developing Space Station. II - Power, rendezvous, docking and remote sensing are important elements of the Space Station p 127 A87-54198 Rendezvous and docking (RVD) long range RF sensor definition study, executive summary [SES/ENG/ES-519/86] p 138 N87-28588 SPACE SHUTTLE MISSION 41-D Test results from the solar array flight experiment p 83 N87-29010 SPACE SHUTTLE MISSION 61-B
satellites p 87 N87-26960  SPACE PLATFORMS  Expert systems in space p 111 A87-32075  The Space Station - Work Package 3 p 118 A87-32529  Advanced technology experiment onboard space platform p 122 A87-32536  Design of a polar platform with an earth observation payload p 122 A87-32536  Concept design and cost estimation of a free-flying space platform p 146 A87-32539  On-orbit fluid management p 132 A87-32534  Magnetic refrigeration for space platforms	possibilities Columbus space station p 161 N87-20637  Data management panel report Columbus polar platforms p 114 N87-20639 The orbit configuration panel report Columbus polar platforms p 157 N87-20640 Panel report on the polar platform servicing approach and its implications Columbus space station p 136 N87-20641 Research in slewing and tracking control p 70 N87-24512 Space station systems: A bibliography with indexes (supplement 4) [NASA-SP-7056(04)] P 4 N87-26073 Propulsion recommendations for space station free	Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Developing Space Station. II - Power, rendezvous, docking and remote sensing are important elements of the Space Station p 127 A87-54198 Rendezvous and docking (RVD) long range RF sensor definition study, executive summary [SES/ENG/ES-519/86] p 138 N87-28588 SPACE SHUTTLE MISSION 41-D Test results from the solar array flight experiment p 83 N87-29010 SPACE SHUTTLE MISSION 61-B Thermal design of the ACCESS erectable space truss p 42 A87-34469
satellites p 87 N87-26960  SPACE PLATFORMS  Expert systems in space p 111 A87-32075  The Space Station - Work Package 3 p 118 A87-32529  Advanced technology experiment onboard space platform p 122 A87-32536  Design of a polar platform with an earth observation payload p 122 A87-32538  Concept design and cost estimation of a free-flying space platform p 146 A87-32539  On-orbit fluid management p 132 A87-32543  Magnetic refrigeration for space platforms [SAE PAPER 861724] p 118 A87-32613	possibilities Columbus space station  p 161 N87-20637  Data management panel report Columbus polar platforms p 114 N87-20639  The orbit configuration panel report Columbus polar platforms p 157 N87-20640  Panel report on the polar platform servicing approach and its implications Columbus space station  p 136 N87-20641  Research in slewing and tracking control  p 70 N87-24512  Space station systems: A bibliography with indexes (supplement 4)  [NASA-SP-7056(04)] p 4 N87-26073  Propulsion recommendations for space station free flying platforms	Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Developing Space Station. II - Power, rendezvous, docking and remote sensing are important elements of the Space Station p 127 A87-54198 Rendezvous and docking (RVD) long range RF sensor definition study, executive summary [SES/ENG/ES-519/86] p 138 N87-28588 SPACE SHUTTLE MISSION 41-D Test results from the solar array flight experiment p 83 N87-29010 SPACE SHUTTLE MISSION 61-B Thermal design of the ACCESS erectable space truss p 42 A87-34469 SPACE SHUTTLE MISSIONS
satellites p 87 N87-26960  SPACE PLATFORMS  Expert systems in space p 111 A87-32075  The Space Station - Work Package 3 p 118 A87-32529  Advanced technology experiment onboard space platform p 122 A87-32536  Design of a polar platform with an earth observation payload p 122 A87-32530  Concept design and cost estimation of a free-flying space platform p 146 A87-32539  On-orbit fluid management p 132 A87-32543  Magnetic refrigeration for space platforms  [SAE PAPER 861724] p 118 A87-32613	possibilities Columbus space station p 161 N87-20637  Data management panel report Columbus polar platforms p 114 N87-20639 The orbit configuration panel report Columbus polar platforms p 157 N87-20640 Panel report on the polar platform servicing approach and its implications Columbus space station p 136 N87-20641 Research in slewing and tracking control p 70 N87-24512 Space station systems: A bibliography with indexe (supplement 4) [NASA-SP-7056(04)] Propulsion recommendations for space station free flying platforms p 98 N87-26129 The evolution of a serviceable EURECA	Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Developing Space Station. II - Power, rendezvous, docking and remote sensing are important elements of the Space Station p 127 A87-54198 Rendezvous and docking (RVD) long range RF sensor definition study, executive summary [SES/ENG/ES-519/86] p 138 N87-28588 SPACE SHUTTLE MISSION 41-D Test results from the solar array flight experiment p 83 N87-29010 SPACE SHUTTLE MISSION 61-B Thermal design of the ACCESS erectable space truss p 42 A87-34469
satellites p 87 N87-26960  SPACE PLATFORMS  Expert systems in space p 111 A87-32075  The Space Station - Work Package 3 p 118 A87-32529  Advanced technology experiment onboard space platform p 122 A87-32536  Design of a polar platform with an earth observation payload A87-32538  Concept design and cost estimation of a free-flying space platform p 146 A87-32539  On-orbit fluid management p 132 A87-32543  Magnetic refrigeration for space platforms  [SAE PAPER 861724] p 118 A87-32613  Use of the Orbital Maneuvering Vehicle (OMV) for placement and retrieval of spacecraft and platforms  [AAS PAPER 86-041] p 133 A87-32743	possibilities Columbus space station  p 161 N87-20637  Data management panel report Columbus polar platforms  The orbit configuration panel report Columbus polar platforms  Panel report on the polar platform servicing approach and its implications Columbus space station  p 136 N87-20640  Research in slewing and tracking control  p 70 N87-24512  Space station systems: A bibliography with indexes (supplement 4)  [NASA-SP-7056(04)]  Propulsion recommendations for space station free flying platforms  p 98 N87-26129  The evolution of a serviceable EURECA  [MBB-UR-E-923/86]  p 121 N87-26841	Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Developing Space Station. II - Power, rendezvous, docking and remote sensing are important elements of the Space Station p 127 A87-54198 Rendezvous and docking (RVD) long range RF sensor definition study, executive summary [SES/ENG/ES-519/86] p 138 N87-28588 SPACE SHUTTLE MISSION 41-D Test results from the solar array flight experiment p 83 N87-29010 SPACE SHUTTLE MISSION 61-B Thermal design of the ACCESS erectable space truss p 42 A87-34469 SPACE SHUTTLE MISSIONS Space Shuttle flight rates and utilization p 1 A87-37963
satellites p 87 N87-26960  SPACE PLATFORMS  Expert systems in space p 111 A87-32075  The Space Station - Work Package 3 p 118 A87-32529  Advanced technology experiment onboard space platform p 122 A87-32536  Design of a polar platform with an earth observation payload p 122 A87-32538  Concept design and cost estimation of a free-flying space platform p 146 A87-32539  On-orbit fluid management p 132 A87-32533  Magnetic refrigeration for space platforms  [SAE PAPER 861724] p 118 A87-32613  Use of the Orbital Maneuvering Vehicle (OMV) for placement and retrieval of spacecraft and platforms [AAS PAPER 86-041] p 133 A87-32743  Alternative methods to fold/deploy tetrahedral or	possibilities Columbus space station p 161 N87-20637  Data management panel report Columbus polar platforms p 114 N87-20639 The orbit configuration panel report Columbus polar platforms p 157 N87-20640 Panel report on the polar platform servicing approach and its implications Columbus space station p 136 N87-20641  Research in slewing and tracking control p 70 N87-24512 Space station systems: A bibliography with indexes (supplement 4) [NASA-SP-7056(04)] Propulsion recommendations for space station free flying platforms p 98 N87-26129 The evolution of a serviceable EURECA [MBB-UR-E-923/86] Mobile remote manipulator vehicle system [NASA-CASF-I AB-13393-1] p 103 N87-29118	Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Developing Space Station. II - Power, rendezvous, docking and remote sensing are important elements of the Space Station p 127 A87-54198 Rendezvous and docking (RVD) long range RF sensor definition study, executive summary [SES/ENG/ES-519/86] p 138 N87-28588 SPACE SHUTTLE MISSION 41-D Test results from the solar array flight experiment p 83 N87-29010 SPACE SHUTTLE MISSION 61-B Thermal design of the ACCESS erectable space truss p 42 A87-34469 SPACE SHUTTLE MISSIONS Space Shuttle flight rates and utilization p 1 A87-37963 SPACE SHUTTLE ORBITERS
satellites p 87 N87-26960  SPACE PLATFORMS  Expert systems in space p 111 A87-32075  The Space Station - Work Package 3 p 118 A87-32529  Advanced technology experiment onboard space platform p 122 A87-32536  Design of a polar platform with an earth observation payload p 122 A87-32539  Concept design and cost estimation of a free-flying space platform p 146 A87-32539  On-orbit fluid management p 132 A87-32539  Magnetic refrigeration for space platforms  [SAE PAPER 861724] p 118 A87-32613  Use of the Orbital Maneuvering Vehicle (OMV) for placement and retrieval of spacecraft and platforms  [AAS PAPER 86-041] p 133 A87-32743  Alternative methods to fold/deploy tetrahedral or pentahedral truss platforms p 19 A87-34467	possibilities Columbus space station  p 161 N87-20637  Data management panel report Columbus polar platforms The orbit configuration panel report Columbus polar platforms Panel report on the polar platform servicing approach and its implications Columbus space station p 136 N87-20640  Research in slewing and tracking control p 70 N87-20641  Space station systems: A bibliography with indexes (supplement 4) [NASA-SP-7056(04)] Propulsion recommendations for space station free flying platforms p 98 N87-26129 The evolution of a serviceable EURECA [MBB-UR-E-923/86] Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] P 103 N87-29118 Phase 3 study of selected tether applications in space.	Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Developing Space Station. II - Power, rendezvous, docking and remote sensing are important elements of the Space Station p 127 A87-54198 Rendezvous and docking (RVD) long range RF sensor definition study, executive summary [SES/ENG/ES-519/86] p 138 N87-28588 SPACE SHUTTLE MISSION 41-D Test results from the solar array flight experiment p 83 N87-29010 SPACE SHUTTLE MISSION 61-B Thermal design of the ACCESS erectable space truss p 42 A87-34469 SPACE SHUTTLE MISSIONS Space Shuttle flight rates and utilization p 1 A87-37963 SPACE SHUTTLE ORBITERS Living in space: A handbook for space travellers p 162 A87-33475
satellites p 87 N87-26960  SPACE PLATFORMS  Expert systems in space p 111 A87-32075  The Space Station - Work Package 3 p 118 A87-32529  Advanced technology experiment onboard space platform p 122 A87-32536  Design of a polar platform with an earth observation payload p 122 A87-32536  Concept design and cost estimation of a free-flying space platform p 146 A87-32539  On-orbit fluid management p 132 A87-32539  Magnetic refrigeration for space platforms  [SAE PAPER 861724] p 118 A87-32613  Use of the Orbital Maneuvering Vehicle (OMV) for placement and retrieval of spacecraft and platforms  [AAS PAPER 86-041] p 133 A87-32743  Alternative methods to fold/deploy tetrahedral or pentahedral truss platforms p 19 A87-34467  Communication missions for geostationary platforms	possibilities Columbus space station  p 161 N87-20637  Data management panel report Columbus polar platforms  The orbit configuration panel report Columbus polar platforms  Panel report on the polar platform servicing approach and its implications Columbus space station  p 136 N87-20640  Research in slewing and tracking control  p 70 N87-24512  Space station systems: A bibliography with indexes (supplement 4)  [NASA-SP-7056(04)]  Propulsion recommendations for space station free flying platforms  The evolution of a serviceable EURECA  [MBB-UR-E-923/86]  MBC-UR-E-923/86]  P 121 N87-26841  Mobile remote manipulator vehicle system  [NASA-CASE-LAR-13393-1]  Phase 3 study of selected tether applications in space.	Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Developing Space Station. II - Power, rendezvous, docking and remote sensing are important elements of the Space Station p 127 A87-54198 Rendezvous and docking (RVD) long range RF sensor definition study, executive summary [SES/ENG/ES-519/86] p 138 N87-28588 SPACE SHUTTLE MISSION 41-D Test results from the solar array flight experiment p 83 N87-29010 SPACE SHUTTLE MISSION 61-B Thermal design of the ACCESS erectable space truss p 42 A87-34469 SPACE SHUTTLE MISSIONS Space Shuttle flight rates and utilization p 1 A87-37963 SPACE SHUTTLE ORBITERS Living in space: A handbook for space travellers p 162 A87-33475 Manned spacecraft electrical power systems
satellites p 87 N87-26980  SPACE PLATFORMS  Expert systems in space p 111 A87-32075  The Space Station - Work Package 3 p 118 A87-32529  Advanced technology experiment onboard space platform p 122 A87-32536  Design of a polar platform with an earth observation payload p 122 A87-32538  Concept design and cost estimation of a free-flying space platform p 146 A87-32539  On-orbit fluid management p 132 A87-32543  Magnetic refrigeration for space platforms  [SAE PAPER 861724] p 118 A87-32613  Use of the Orbital Maneuvering Vehicle (OMV) for placement and retrieval of spacecraft and platforms  [AAS PAPER 86-041] p 133 A87-32743  Alternative methods to fold/deploy tetrahedral or pentahedral truss platforms p 19 A87-34467  Communication missions for geostationary platforms p 84 A87-34797	possibilities Columbus space station  p 161 N87-20637  Data management panel report Columbus polar platforms  The orbit configuration panel report Columbus polar platforms  p 114 N87-20639  The orbit configuration panel report Columbus polar platforms  p 157 N87-20640  Panel report on the polar platform servicing approach and its implications Columbus space station  p 136 N87-20641  Research in slewing and tracking control  p 70 N87-2641  Space station systems: A bibliography with indexes (supplement 4)  [NASA-SP-7056(04)]  p 4 N87-26073  Propulsion recommendations for space station free flying platforms  p 98 N87-26129  The evolution of a serviceable EURECA  [MBB-UR-E-923/86]  Mobile remote manipulator vehicle system  [NASA-CASE-LAR-13393-1]  Phase 3 study of selected tether applications in space.  Volume 1: Executive summary  [NASA-CR-179185]  p 131 N87-29585	Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Developing Space Station. II - Power, rendezvous, docking and remote sensing are important elements of the Space Station p 127 A87-54198 Rendezvous and docking (RVD) long range RF sensor definition study, executive summary [SES/ENG/ES-519/86] p 138 N87-28588 SPACE SHUTTLE MISSION 41-D Test results from the solar array flight experiment p 83 N87-29010 SPACE SHUTTLE MISSION 61-B Thermal design of the ACCESS erectable space truss p 42 A87-34469 SPACE SHUTTLE MISSIONS Space Shuttle flight rates and utilization p 1 A87-37963 SPACE SHUTTLE ORBITERS Living in space: A handbook for space travellers p 162 A87-33475 Manned spacecraft electrical power systems p 75 A87-37291
satellites p 87 N87-26960  SPACE PLATFORMS  Expert systems in space p 111 A87-32075  The Space Station - Work Package 3 p 118 A87-32529  Advanced technology experiment onboard space platform p 122 A87-32536  Design of a polar platform with an earth observation payload p 122 A87-32536  Concept design and cost estimation of a free-flying space platform p 146 A87-32539  On-orbit fluid management p 132 A87-32539  Magnetic refrigeration for space platforms  [SAE PAPER 861724] p 118 A87-32613  Use of the Orbital Maneuvering Vehicle (OMV) for placement and retrieval of spacecraft and platforms  [AAS PAPER 86-041] p 133 A87-32743  Alternative methods to fold/deploy tetrahedral or pentahedral truss platforms p 19 A87-34467  Communication missions for geostationary platforms  P 84 A87-34797	possibilities Columbus space station  p 161 N87-20637  Data management panel report Columbus polar platforms p 114 N87-20639  The orbit configuration panel report Columbus polar platforms p 157 N87-20640  Panel report on the polar platform servicing approach and its implications Columbus space station p 136 N87-20641  Research in slewing and tracking control p 70 N87-24512  Space station systems: A bibliography with indexes (supplement 4) [NASA-SP-7056(04)] p 4 N87-26073  Propulsion recommendations for space station free flying platforms p 98 N87-26129  The evolution of a serviceable EURECA [MBB-UR-E-923/86] p 121 N87-26841  Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 103 N87-29118  Phase 3 study of selected tether applications in space. Volume 1: Executive summary [NASA-CR-179185] p 131 N87-29585	Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Developing Space Station. II - Power, rendezvous, docking and remote sensing are important elements of the Space Station p 127 A87-54198 Rendezvous and docking (RVD) long range RF sensor definition study, executive summary [SES/ENG/ES-519/86] p 138 N87-28588 SPACE SHUTTLE MISSION 41-D Test results from the solar array flight experiment p 83 N87-29010 SPACE SHUTTLE MISSION 61-B Thermal design of the ACCESS erectable space truss p 42 A87-34469 SPACE SHUTTLE MISSIONS Space Shuttle flight rates and utilization p 1 A87-37963 SPACE SHUTTLE ORBITERS Living in space: A handbook for space travellers p 162 A87-33475 Manned spacecraft electrical power systems p 75 A87-37291 Shuttle orbit flight control design lessons - Direction for
SPACE PLATFORMS  Expert systems in space p 111 A87-32075  The Space Station - Work Package 3 p 118 A87-32529  Advanced technology experiment onboard space platform p 122 A87-32536  Design of a polar platform with an earth observation payload p 122 A87-32536  Concept design and cost estimation of a free-flying space platform p 146 A87-32539  On-orbit fluid management p 132 A87-32539  On-orbit fluid management p 132 A87-32543  Magnetic refrigeration for space platforms  [SAE PAPER 861724] p 118 A87-32613  Use of the Orbital Maneuvering Vehicle (OMV) for placement and retrieval of spacecraft and platforms  [AAS PAPER 86-041] p 133 A87-32743  Alternative methods to fold/deploy tetrahedral or pentahedral truss platforms p 19 A87-34467  Communication missions for geostationary platforms p 84 A87-34797  Mechanical design of the Eurostar platform	possibilities Columbus space station  p 161 N87-20637  Data management panel report Columbus polar platforms p 114 N87-20639  The orbit configuration panel report Columbus polar platforms p 157 N87-20640  Panel report on the polar platform servicing approach and its implications Columbus space station  p 136 N87-20641  Research in slewing and tracking control  p 70 N87-24512  Space station systems: A bibliography with indexes (supplement 4)  [NASA-SP-7056(04)] p 4 N87-26073  Propulsion recommendations for space station free flying platforms p 8 N87-26129  The evolution of a serviceable EURECA  [MBB-UR-E-923/86] p 121 N87-26841  Mobile remote manipulator vehicle system  [NASA-CASE-LAR-13393-1] p 103 N87-29118  Phase 3 study of selected tether applications in space.  Volume 1: Executive summary  [NASA-CR-179185] p 131 N87-29585  SPACE POWER REACTORS  EBATO orbital transfer vehicle with electronuclear power	Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Developing Space Station. II - Power, rendezvous, docking and remote sensing are important elements of the Space Station p 127 A87-54198 Rendezvous and docking (RVD) long range RF sensor definition study, executive summary [SES/ENG/ES-519/86] p 138 N87-28588 SPACE SHUTTLE MISSION 41-D Test results from the solar array flight experiment p 83 N87-29010 SPACE SHUTTLE MISSION 61-B Thermal design of the ACCESS erectable space truss p 42 A87-34469 SPACE SHUTTLE MISSIONS Space Shuttle flight rates and utilization p 1 A87-37963 SPACE SHUTTLE ORBITERS Living in space: A handbook for space travellers p 162 A87-33475 Manned spacecraft electrical power systems p 75 A87-37291 Shuttle orbit flight control design lessons - Direction for Space Station p 58 A87-37295
SPACE PLATFORMS  Expert systems in space p 111 A87-32075  The Space Station - Work Package 3 p 118 A87-32529  Advanced technology experiment onboard space platform p 122 A87-32536  Design of a polar platform with an earth observation payload p 122 A87-32530  Concept design and cost estimation of a free-flying space platform p 146 A87-32539  On-orbit fluid management p 132 A87-32539  On-orbit fluid management p 132 A87-32543  Magnetic refrigeration for space platforms  [SAE PAPER 861724] p 118 A87-32613  Use of the Orbital Maneuvering Vehicle (OMV) for placement and retrieval of spacecraft and platforms  [AAS PAPER 86-041] p 133 A87-32743  Alternative methods to fold/deploy tetrahedral or pentahedral truss platforms p 19 A87-34467  Communication missions for geostationary platforms p 84 A87-34797  Mechanical design of the Eurostar platform p 149 A87-34874  The capabilities of Eureca thermal control for future	possibilities Columbus space station  p 161 N87-20637  Data management panel report Columbus polar platforms p 114 N87-20639  The orbit configuration panel report Columbus polar platforms p 157 N87-20640  Panel report on the polar platform servicing approach and its implications Columbus space station p 136 N87-20641  Research in slewing and tracking control p 70 N87-24512  Space station systems: A bibliography with indexes (supplement 4) [NASA-SP-7056(04)] p 4 N87-26073  Propulsion recommendations for space station free flying platforms p 98 N87-26129  The evolution of a serviceable EURECA [MBB-UR-E-923/86] p 121 N87-26841  Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 103 N87-29118  Phase 3 study of selected tether applications in space. Volume 1: Executive summary [NASA-CR-179185] p 131 N87-29585  SPACE POWER REACTORS  ERATO orbital transfer vehicle with electronuclear power Study of the associated electronuclear generator p 75 A87-36944	Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Developing Space Station. II - Power, rendezvous, docking and remote sensing are important elements of the Space Station p 127 A87-54198 Rendezvous and docking (RVD) long range RF sensor definition study, executive summary [SES/ENG/ES-519/86] p 138 N87-28588 SPACE SHUTTLE MISSION 41-D Test results from the solar array flight experiment p 83 N87-29010 SPACE SHUTTLE MISSION 61-B Thermal design of the ACCESS erectable space truss p 42 A87-34469 SPACE SHUTTLE MISSIONS Space Shuttle flight rates and utilization p 1 A87-37963 SPACE SHUTTLE ORBITERS Living in space: A handbook for space travellers p 152 A87-33475 Manned spacecraft electrical power systems p 75 A87-37291 Shuttle orbit flight control design lessons - Direction for Space Station p 58 A87-37295 Soft mounted momentum compensated pointing systems
SPACE PLATFORMS  Expert systems in space p 111 A87-32075  The Space Station - Work Package 3 p 118 A87-32529  Advanced technology experiment onboard space platform p 122 A87-32536  Design of a polar platform with an earth observation payload p 122 A87-32536  Concept design and cost estimation of a free-flying space platform p 146 A87-32539  On-orbit fluid management p 132 A87-32539  On-orbit fluid management p 132 A87-32543  Magnetic refrigeration for space platforms  [SAE PAPER 861724] p 118 A87-32613  Use of the Orbital Maneuvering Vehicle (OMV) for placement and retrieval of spacecraft and platforms  [AAS PAPER 86-041] p 133 A87-32743  Alternative methods to fold/deploy tetrahedral or pentahedral truss platforms p 19 A87-34467  Communication missions for geostationary platforms p 84 A87-34797  Mechanical design of the Eurostar platform	possibilities Columbus space station p 161 N87-20637  Data management panel report Columbus polar platforms p 114 N87-20639 The orbit configuration panel report Columbus polar platforms p 157 N87-20640 Panel report on the polar platform servicing approach and its implications Columbus space station p 136 N87-20641 Research in slewing and tracking control p 70 N87-2641 Space station systems: A bibliography with indexes (supplement 4) [NASA-SP-7056(04)] p 4 N87-26073 Propulsion recommendations for space station free flying platforms p 8 N87-26129 The evolution of a serviceable EURECA [MBB-UR-E-923/86] p 121 N87-26841 Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 103 N87-29118 Phase 3 study of selected tether applications in space. Volume 1: Executive summary [NASA-CR-179185] p 131 N87-2985 SPACE POWER REACTORS ERATO orbital transfer vehicle with electronuclear power	Control of an autonomous spacecraft rendezvous and docking maneuver by means of image processing [DGLR PAPER 86-122] p 101 A87-48156 Developing Space Station. II - Power, rendezvous, docking and remote sensing are important elements of the Space Station p 127 A87-54198 Rendezvous and docking (RVD) long range RF sensor definition study, executive summary [SES/ENG/ES-519/86] p 138 N87-28588 SPACE SHUTTLE MISSION 41-D Test results from the solar array flight experiment p 83 N87-29010 SPACE SHUTTLE MISSION 61-B Thermal design of the ACCESS erectable space truss p 42 A87-34469 SPACE SHUTTLE MISSIONS Space Shuttle flight rates and utilization p 1 A87-37963 SPACE SHUTTLE ORBITERS Living in space: A handbook for space travellers p 162 A87-33475 Manned spacecraft electrical power systems p 75 A87-37291 Shuttle orbit flight control design lessons - Direction for space travellers p 75 A87-37291

[AIAA PAPER 87-1102] p 76 A87-41145 Two-phase reduced gravity experiments for a space reactor design p 8 N87-21154

satellites

Space Station/Shuttle Orbiter docking

dynamics during p 65 N87-22708

Development of the electrical power subsystem for the electric propulsion experiment onboard the Space Flyer Unit (SFU)

[AIAA PAPER 87-1040] p 76 A87-39628

unit operations

[SAE PAPER 861783]

**[SAE PAPER 861784]** 

A simulation capability for future space flight

p 47 A87-32632

p 99 A87-32633

Track and capture of the orbiter with the space station Design and development of a Space Station proximity Land panel report --- International Space Station remote manipulator system operations research and development mockup p 128 N87-20634 [NASA-TM-89221] p 137 N87-25339 [SAE PAPER 861785] p 133 A87-32634 Solid Earth panel report --- Columbus program The design and development of a mobile transporter High intensity 5 eV atomic oxygen source and Low Earth p 157 N87-20636 system for the Space Station Remote Manipulator Orbit (LEO) simulation facility p 141 N87-26186 Neutral atomic oxygen beam produced by ion charge Panel report on new approaches to calibration and System p 104 N87-29865 validation --- Columbus polar platforms exchange for Low Earth Orbital (LEO) simulation Space Station based options for orbiter p 157 N87-20638 docking/berthing p 138 N87-29877 p 131 N87-26188 Data management panel report --- Columbus polar SPACE SHUTTLE PAYLOADS Pulsed source of energetic atomic oxygen platforms p 114 N87-20639 p 108 N87-26189 Solar array flight dynamic experiment The orbit configuration panel report --- Columbus polar [AAS PAPER 86-050] Martin Marietta atomic oxygen Low Earth Orbit (LEO) p 75 A87-32747 p 157 N87-20640 platforms Electrodynamic plasma motor/generator experiment [AAS PAPER 86-210] p 89 A87-38569 p 142 N87-26204 Panel report on the polar platform servicing approach SPACE STATION PAYLOADS p 89 A87-38569 and its implications --- Columbus space station On the payload-tether technology providing the Liquid droplet radiator development status --- waste heat p 136 N87-20641 microgravity circumstances in the proximity of the Space rejection devices for future space vehicles SPACE STATION POWER SUPPLIES p 122 A87-32533 Station [AIAA PAPER 87-1537] p 111 A87-32075 p 43 A87-43059 Expert systems in space Design of a polar platform with an earth observation The tethered satellite system Solar concentrator system for experiments in the Space for low density p 122 A87-32538 Station aerothermodynamics studies p 127 A87-52450 n 146 A87-32525 Science and payload options for animal and plant Power management equipment for space applications Gas tungsten arc welding in a microgravity environment: research accommodations aboard the early Space (SAE PAPER 861621) Work done on GAS payload G-169 p 74 A87-32578 p 136 N87-20306 An integrated analytic tool and knowledge-based system Use of lightweight composites for GAS payload p 25 N87-20307 [SAE PAPER 860953] p 164 A87-38740 approach to aerospace electric power system control structures Servicing of user payload equipment in the Space Station [SAE PAPER 861622] p 74 A87-32579 Progress on the Ohio State University Get Away Special pressurized environment Advanced technology for extended endurance alkaline G-0318: DFAP p 170 N87-20311 [SAE PAPER 860973] p 134 A87-38755 The growth and harvesting of algae in a micro-gravity p 75 A87-33787 Linear quadratic control system design for Space Station Intelligent flywheel energy storage units with additional pointed payloads [AIAA PAPER 87-2530] environment p 165 N87-20325 functions for future space stations in near-earth orbits Satellite servicing mission preliminary cost estimation p 161 A87-50533 [DGLR PAPER 86-172] p 57 A87-36762 Payload data management scheme planned for Earth Optimization of heat rejection subsystem for solar NASA-CR-1719781 p 136 N87-20335 observation sensors to be flown on the polar platforms dynamic Brayton cycle power system Liquid droplet radiator development status in the framework of the space station/Columbus [SAE PAPER 860999] [NASA-TM-89852] p 43 A87-38776 p 44 N87-20353 program p 114 N87-20630 20 kHz Space Station power system Influence co-efficient testing as a substitute for modal Cooperation of the International Space Station partners p 76 A87-40378 survey testing of large space structures in the preparation of the use of space station elements Survey of solar-dynamic space power - The Stirling p 27 N87-20369 for Earth observation (platform and payload aspects) p 77 A87-42265 option Solar array flight experiment/dynamic augmentation p 128 N87-20631 A comparison of scheduling algorithms for autonomous experiment An astrometric facility for planetary detection on the management of the Space Station electric energy [NASA-TP-26901 p 63 N87-20380 space station system Shuttle middeck fluid transfer experiment: Lessons [NASA-TM-89436] p 128 N87-20841 [AIAA PAPER 87-2467] p 77 A87-50511 Impact of space station appendage vibrations on the p 95 N87-21158 Developing Space Station. II - Power, rendezvous. Structural/control interaction (payload pointing and pointing performance of gimballed payloads docking and remote sensing are important elements of micro-o) p 32 N87-22733 р9 N87-22721 the Space Station p 127 A87-54198 Contamination assessment for OSSA space station IOC Optimization of payload mass placement in a dual keel Space station electric power system requirements and space station [NASA-CR-181165] design [NASA-TM-89889] [NASA-TM-89051] p 141 N87-26082 p 68 N87-23687 p 96 N87-22001 Contamination assessment for OSSA space station IOC Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340 Speculations on future opportunities to evolve Brayton p 158 N87-25340 powerplants aboard the space station [NASA-CR-4091] p 53 N87-26086 Contamination assessment for OSSA space station IOC [NASA-TM-89863] p 121 N87-23674 Space station WP-04 power system. Volume 1: SPACE SHUTTLE UPPER STAGES pavloads Commercial US transfer vehicle overview [NASA-CR-181165] p 141 N87-26082 Executive summary [NASA-CR-179587-VOL-1] [SAE PAPER 861764] p 1 A87-32625 Contamination assessment for OSSA space station IOC p 78 N87-23695 NERVA derived nuclear orbit transfer system pavloads Space station WP-04 power system. Volume 2: Study [NASA-CR-4091] [AIAA PAPER 87-2155] p 92 A87-45439 p 53 N87-26086 results SPACE SHUTTI ES SPACE STATION POLAR PLATFORMS [NASA-CR-179587-VOL-2] p 79 N87-23696 The Industrial Space Facility p 167 A87-38579 Design of a polar platform with an earth observation Status of space station power system The mechanics of manufacturing in space pavload p 122 A87-32538 p 84 N87-29915 A polar platform for the remote sensing needs of ecology D 167 A87-40068 Advanced fuel cell concepts for future NASA missions The Soviet space shuttle programme and agriculture - A view from the U.K. p 99 N87-29930 p 153 A87-47302 p 125 A87-41430 Regenerative fuel cells for space applications Space Station opportunity for UK in earth sensing p 152 A87-41678 Ram ion scattering caused by Space Shuttle  $v \times B$ p 84 N87-29938 induced differential charging p 140 A87-51713 SPACE STATION PROPULSION Influence co-efficient testing as a substitute for modal Earth resources instrumentation for the Space Station The use of electric propulsion on low earth orbit survey testing of large space structures Polar Platform D 126 A87-44184 spacecraft p 27 N87-20369 Servicing of the polar platform --- Columbus space The dynamics and control of the Space Station polar [AIAA PAPER 87-0989] p 88 A87-38003 Dynamic behavior of astronauts and satellites outside station p 136 N87-20628 [AIAA PAPER 87-2600] p 62 A87-50562 an orbiting space station under the influence of thrust Department of Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Housing and Urhan p 52 A87-41666 Development-independent agencies appropriations for Space Station propulsion system test bed and control Remote-Sensing (ESPOIR) system testing results [GPO-73-418] p 171 N87-22560 [ESA-SP-2661 p 128 N87-20621 [AIAA PAPER 87-1858] p 91 A87-45255 Optimal shuttle altitude changes using tethers The Earth observation activities of the European Space Conceptual design and integration of a Space Station [AD-A179205] p 129 N87-22756 Agency and the use of the polar platform of the resistojet propulsion assembly National Aeronautics and Space Administration International Space Station p 128 N87-20622 [AIAA PAPER 87-1860] p 91 A87-45256 Authorization Act Working group on Earth observation requirements for The impact of integrated water management on the Space Station propulsion system [S-REPT-100-87] p 171 N87-24240 the Polar Orbiting Platform Elements of the International Antenna Technology Shuttle Experiment (ATSE) Space Station (the POPE Working Group) [AIAA PAPER 87-1864] p 91 A87-45259 p 87 N87-24508 p 128 N87-20625 Effect of nozzle geometry on the resistojet exhaust Minimum time attitude slewing maneuvers of a rigid ESA Columbus polar platform design concept spacecraft [AIAA PAPER 87-2121] p 156 N87-20627 p 62 A87-52252 [NASA-CR-1811301 p 72 N87-26038 Servicing of the polar platform --- Columbus space ation p 136 N87-20628 Conceptual design and integration of a space station NASA authorization: Authorization of appropriations for resistojet propulsion assembly station the National Aeronautics and Space Administration for INASA-TM-898471 Orbit configurations --- space station polar platform p 93 N87-20378 fiscal year 1988 [GPO-73-245] Density uncertainty effect on cost of space station p 170 N87-20667 p 156 N87-20629 p 172 N87-30221 SPACE SIMULATORS Payload data management scheme planned for Earth Space station momentum management Space Station EVA simulation demonstrates orbital observation sensors to be flown on the polar platforms p 64 N87-20668 the framework of the space station/Columbus p 132 A87-32006 Space station control moment gyro control A space debris simulation facility for spacecraft materials program p 114 N87-20630 p 64 N87-20669 evaluation Cooperation of the International Space Station partners p 11 A87-32058 Hydrogen/oxygen economy for the space station Laboratory simulation of plasma interaction with high in the preparation of the use of space station elements for Earth observation (platform and payload aspects) p.98 N87-26130 voltage solar алтау p 145 A87-32388 Space station propulsion test bed: A complete system Computer simulation of on-orbit manned maneuvering

p 128 N87-20631

p 170 N87-20632

p 161 N87-20633

USA-Europe coordination and cooperation activities:

Announcements of Opportunity --- polar platforms

Report of the atmosphere panel

p 98 N87-26131

p 98 N87-26133

A 25-LBF gaseous oxygen/gaseous hydrogen thruster r space station application p 98 N87-26132

Proven, long-life hydrogen/oxygen thrust chambers for

for space station application

space station propulsion

## **SPACE STATION STRUCTURES**

Space station propulsion-ECLSS interaction study [NASA-CR-175093] p 54 N87-29594	Concept study of regenerable carbon dioxide remo and oxygen recovery system for the Space Station p 46 A87-325
SPACE STATION STRUCTURES  Development of exposed deck of Japanese experiment	Structure and function of Deployable Truss Be
modulo D 145 A87-32532	(DTB) p 12 A87-325 Evaluation testing of a mechanical actuator component
An enclosed hangar concept for large spacecraft servicing at Space Station p 146 A87-32534	operating in a simulated space environment
Study of actuator for large space manipulator arm	p 160 A87-325 Magnetic refrigeration for space platforms
p 12 A87-32545 Structure and function of Deployable Truss Beam	read DADER 8617241 D 118 A87-320
(DTB) p 12 A87-32546	Design and development of a Space Station proxin operations research and development mockup
Development status of a two-phase thermal management system for large spacecraft	[SAF PAPER 861785] P 133 A87-320
[CAE DADED 861828] D 41 A87-32002	Design of an advanced two-phase capillary cold pl
An equivalent continuum analysis procedure for Space Station lattice structures	[SAE PAPER 861829] p 41 A87-321 Environmental avoidance concepts for steerable Sp.
[AIAA DADER 87-0724] D 13 A87-33564	Station radiators
Composite tubes for the Space Station truss structure	[SAE PAPER 861831] p 41 A87-32 Role of the manned maneuvering unit for the Sp
Dynamic analysis and experiment methods for a generic	Station
space station model p 22 A87-41613 Adaptive momentum management for the dual keel	[SAE PAPER 861834] p 133 A87-32 Prototype thermal bus for manned Space Sta
Space Station	compartments
[AIAA PAPER 87-2596] p 62 A87-50558 Space station structures and dynamics test program	[SAE PAPER 861825] p 41 A87-32 System level verification applying the Space Shu
[NIACA_TD_2710] D 28 N87-20300	experience to the Space Station
Considerations in the design and development of a space station scale model p 9 N87-22711	[AAS PAPER 86-001] p 55 A87-32 The Softmounted Inertially Reacting Pointing Sys
Dual keel space station control/structures interaction	(SIRPNT)
study p 67 N87-22737 Space station structures and dynamics test program	Stability in the relative equilibrium positions of sp
D 33 N87-22751	stations at triangular libration points in
Space station structural dynamics/reaction control	ISOKIN - A quantitative model of the kinesthetic asp
system interaction study p 67 N87-22753  Adaptive momentum management for large space	of spatial habitability p 162 A87-33 The use of multidimensional scaling for facilities la
structures - C7 NO7 22759	- An application to the design of the Space Station
Dynamic and thermal response finite element models	p 118 A87-3: An evaluation of menu systems for Space Sta
of multi-body space structural configurations [NASA-CR-178289] p 10 N87-24709	interfaces p 111 A87-3
CRACE STATIONS	User interface design guidelines for extroubleshooting systems for Space Station
Space Station integration and verification concepts p 84 A87-31461	p6 A87-3
Multiple Access Ku-band communications subsystem for the Space Station p 84 A87-31462	Living in space: A handbook for space travellers p 162 A87-3
Head-ported display analysis for Space Station	An equivalent continuum analysis procedure for S
endications 0 111 A87-31403	Station lattice structures [AIAA PAPER 87-0724] p 13 A87-3
Space Station EVA simulation demonstrates orbital assembly p 132 A87-32006	Modal analyses of dynamics of a deformable multi
Selected materials issues associated with Space	spacecraft - The Space Station: A continuum appl [AIAA PAPER 87-0925] p 17 A87-3
Determination of the cross-sectional temperature	Dynamic and attitude control characteristics
distribution and boiling limitation of a heat pipe p 40 A87-32175	International Space Station [AIAA PAPER 87-0931] p 57 A87-3
NASA's space program - Space Station: A status report	The station is raising lots of questions about s
and a view of its value for space science p 1 A87-32277	Space Station - Opportunities for the life sciences
High thermal capacity evaporator and condensers for	p 122 A87-3  Development of harmonic drive actuator for
Space Station thermal control p 41 A87-32377	manipulator p 149 A87-
and concentration system for CELSS ID 46 A87-32455	Astrometric telescope of ten microarcsecond according to the Space Station p 122 A87-5
Development of carbon dioxide removal system Experimental study of solid amines p 145 A87-32456	on the Space Station p 122 A87- Safety on the Space Station p 162 A87-
Gas and water recycling system for IOC vivarium	When the doctor is 200 miles away p 47 A87-
experiments Initial Operational Capacity p 46 A87-32457	Design considerations for long-lived glass mirro
Water recycling system using thermopervaporation	space p 123 A87-
method p 46 A87-32458 Water recycling for Space Station p 46 A87-32459	distribution system p 75 A87-
Space Station - Overview of the European concept of	Space Station data management system architecture p 111 A87-
Columbus programme status and content p 145 A87-32528	Space station data management system - A co
The Space Station - Work Package 3 p 118 A87-32529	GSE test interface for systems testing and verifical p 112 A87-
Space Station program in a long-range space	Shuttle orbit flight control design lessons - Direct
development scenario of Japan p 145 A87-32330	Space Station p 58 A87- Space Station communications and tracking sys
Status of Japanese Experiment Module design p 145 A87-32531	p 134 A87-
Development of exposed deck of Japanese experiment	Real-time simulation for Space Station p 7 A87-
On the navigad-tether technology providing the	Manned spacecraft automation and robotics p 100 A87
microgravity circumstances in the proximity of the Space	Space Shuttle flight rates and utilization
Station p 122 A87-32533 An enclosed hangar concept for large spacecraft	p 1 A87
servicing at Space Station p 146 A87-32334	Flunking on Space Station cooperation? p 150 A87
Eureca - A first step towards the Space Station p 146 A87-32537	International SAMPE Technical Conference,
Design of a polar platform with an earth observation	Seattle, WA, Oct. 7-9, 1986, Proceedings p 167 A87
payload p 122 A87-32538	The Industrial Space Facility p 167 A87
Payload boomerang technology for space experiments at very low gravity level p 146 A87-32540	Composite tubes for the Space Station truss str p 20 A87
Autonomous decentralized system concept for Space	Effects of varying environmental parameters of
Station p 146 A87-32541	contaminant concentrations in the NASA Space Reference Configuration
Japanese experiment module data management and communication system p 147 A87-32542	[SAE PAPER 860916] p 47 A87

```
EDC development and testing for the Space Station
Concept study of regenerable carbon dioxide removal
                                                                                                     Dioxide
                                                                         Electrochemical
                                                                                           Carbon
                                                         program
                                                          Concentration
                                 p 46 A87-32544
                                                                                            p 118 A87-38710
                                                         [SAE PAPER 860918]
                           eployable Truss Beam
                                                           A Space Station utility - Static Feed Electrolyzer
                                 p 12 A87-32548
                                                                                            p 47 A87-38712
                                                         [SAE PAPER 860920]
                           nical actuator component
                                                           Radiation dose prediction for Space Station
                                                                                           p 139 A87-38715
                                                         [SAE PAPER 860924]
                                 p 160 A87-32549
                                                            Hyperbaric oxygen therapy for decompression accidents
                                                          Potential applications to Space Station Operation
                                 p 118 A87-32613
                                                                                            p 163 A87-38717
                                                         [SAE PAPER 860927]
                           a Space Station proximity
                                                           Habitation module for the Space Station
                                                         [SAE PAPER 860928]
                                                                                            p 163 A87-38718
                                 p 133 A87-32634
                                                            Space Station Food System
                           phase capillary cold plate
                                                                                             p 48 A87-38720
                                                         [SAE PAPER 860930]
                                  p 41 A87-32663
                                                            Space Station personal hygiene study
                           cepts for steerable Space
                                                                                            p 163 A87-38721
                                                         [SAE PAPER 860931]
                                                            Space Station galley design
                                  p 41 A87-32665
                                                                                            p 119 A87-38722
                                                          [SAE PAPER 860932]
                           vering unit for the Space
                                                            A maintenance work station for Space Station
                                                                                            p 167 A87-38723
                                                          [SAE PAPER 860933]
                                 p 133 A87-32667
                                                            Analysis of crew functions as an aid in Space Station
                            manned Space Station
                                                          interior layout
                                                                                            p 163 A87-38724
                                                          [SAE PAPER 860934]
                                  p 41 A87-32668
                                                            System aspects of Columbus thermal control
                           plying the Space Shuttle
                                                                                            p 150 A87-38727
                                                          [SAE PAPER 860938]
                                                            Space Station environmental control and life support
                                  p 55 A87-32727
                                                           system distribution and loop closure studies
                           Reacting Pointing System
                                                                                              p 48 A87-38729
                                                          [SAE PAPER 860942]
                                                            Status of the Space Station environmental control and
                                  p 56 A87-32732
                                                          life support system design concept [SAE PAPER 860943]
                           ilibrium positions of space
                                                                                              p 48 A87-38730
                                                             Environmental Control Life Support for the Space
                           problem p 1 A87-32802
                                                           Station
                           of the kinesthetic aspects
                                                                                              D 48 A87-38731
                                                          [SAE PAPER 860944]
                                  p 162 A87-33002
                                                            Nuclear powered submarines and the Space Station -
                            scaling for facilities layout
                                                            comparison of ECLSS requirements
                                                                                              p 48 A87-38732
                                                           [SAE PAPER 860945]
                                  p 118 A87-33003
                                                             Integrated air revitalization system for Space Station
                           stems for Space Station
                                                           [SAE PAPER 8609461
                                                                                                    A87-38733
                            p 111 A87-33040
guidelines for expert
                                                            Evaluation of regenerative portable life support system
                                                                                               p 49 A87-38735
                                                           [SAE PAPER 860948]
                                    p 6 A87-33050
                                                             Space Station life support oxygen generation by SPE
                                                             ater electrolyzer systems
                                  p 162 A87-33475
                                                                                               p 49 A87-38736
                                                           [SAE PAPER 860949]
                           alysis procedure for Space
                                                             Science and payload options for animal and plant
                                                            research accommodations aboard the early Space
                                    p 13 A87-33564
                                                           Station
                           s of a deformable multibody
                                                                                              p 164 A87-38740
                                                           [SAE PAPER 860953]
                           ion: A continuum approach
                                                             Special considerations in outfitting a space station
                                    p 17 A87-33727
                                                            module for scientific use
                           introl characteristics of an
                                                                                              n 164 A87-38741
                                                           [SAE PAPER 860956]
                                                             Science Research Facilities - Versatility for Space
                                    p 57 A87-33731
                                                            Station
                           of questions about space
                                                                                              p 119 A87-38742
                                                           [SAE PAPER 860958]
                                   p 167 A87-34597
                                                             Columbus Life Support System and its technology
                                   p 122 A87-34871
                                                            development
                                                                                              p 150 A87-38748
                                                            [SAE PAPER 860966]
                           ic drive actuator for space
                                                              An evolutionary approach to the development of a
                                   p 149 A87-35076
                                                            CELSS based air revitalization system
                           en microarcsecond accuracy
                                                                                               p 49 A87-38750
                                                            [SAE PAPER 860968]
                                   p 122 A87-35222
                                                              Conceptual planning for Space Station life sciences
                                   p 162 A87-35599
                                                            human research project
                                                                                               p 164 A87-38751
                                                            [SAE PAPER 860969]
                           p 47 A87-35600
long-lived glass mirrors for
                                                                                            Facility
                                                                                                     automation
                                                              Life Sciences Research
                                                             requirements and concepts for the Space Station
                                   p 123 A87-36531
                                                                                                p 50 A87-38752
                                                            [SAE PAPER 860970]
                                   management and
                                                              Habitability issues for the Science Laboratory Module
                                    p 75 A87-36913
                                                                                               p 50 A87-38753
                                                            [SAE PAPER 860971]
                           ement system architecture
                                                              Concepts for the evolution of the Space Station
                                   p 111 A87-37293
                           gement system - A common
                                                            Program
                                                                                               p 120 A87-38754
                                                            [SAE PAPER 860972]
                           ns testing and verification
                                                              Servicing of user payload equipment in the Space Station
                                   p 112 A87-37294
                                                            pressurized environment
                           design lessons - Direction for
                                                                                               p 134 A87-38755
                                                            [SAE PAPER 860973]
                                    p 58 A87-37295
                                                              Life Science Research Facility materials management
                           tions and tracking system
                                                             requirements and concepts
                                    p 134 A87-37297
                                                                                               p 124 A87-38756
                                                            [SAE PAPER 860974]
                                                              Plant and animal accommodation for Space Station
                                      p 7 A87-37298
                                                             Laboratory
                                                                                               p 124 A87-38757
                                                            [SAE PAPER 860975]
                                    p 100 A87-37300
                                                              Enhanced evaporative surface for two-phase mounting
                                      p 1 A87-37963
                                                             niates
                                                                                                p 42 A87-38760
                                                             [SAE PAPER 860979]
                                                              Pre- and post-treatment techniques for spacecraft water
                           p 150 A87-37964
schnical Conference, 18th,
                                                             recovery
                                                                                                p 50 A87-38761
                                                             [SAE PAPER 860982]
                                                               Phase change water recovery for Space Station -
                                    p 167 A87-38576
p 167 A87-38579
                                                             Parametric testing and analysis
                                                                                                 n 51 A87-38765
                                                             [SAE PAPER 860986]
                           Space Station truss structure
                                                               Air Evaporation closed cycle water recovery technology
                                     p 20 A87-38601
                                                              Advanced energy saving designs
                           nmental parameters on trace
                                                                                                p 51 A87-38766
                                                             [SAE PAPER 860987]
                            in the NASA Space Station
                                                               Space Station EVA systems trade-off model
                                                                                               p 134 A87-38767
                                                             [SAE PAPER 860990]
                                      p 47 A87-38708
```

SUBJECT INDEX Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769 Supercritical water oxidation - Concept analysis for volutionary Space Station application [SAE PAPER 860993] p 51 A87-38770 CELSS waste management systems evaluation [SAE PAPER 860997] p 51 A87 p 51 A87-38774 Evaluation of Space Station thermal control techniques [SAE PAPER 860998] n 42 A87-38775 Maintenance components for Space Station long life fluid systems [SAE PAPER 861005] D 89 A87-38778 Control/monitor instrumentation for environmental control and life support systems aboard the Space [SAE PAPER 861007] p 52 A87-38779 An evaluation of options to satisfy Space Station EVA [SAE PAPER 861008] p 134 A87-38780 An evaluation of advanced extravehicular crew [SAE PAPER 861009] p 134 A87-38781 Space Station EVA using a maneuvering enclosure [SAE PAPER 861010] p 135 A87-38782 The next step for the MMU -Capabilities and nhancements [SAE PAPER 861013] p 160 A87-38783 The mechanics of manufacturing in space p 167 A87-40068 Proposed application of automated biomonitoring for rapid detection of toxic substances in water supplies for permanent space stations p 164 A87-40098 Advanced technology for the Space Station p 120 A87-40353 An operations management system for the Space Station p 112 A87-40358 Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363 p 135 A87-40376 On-orbit assembly and repair Planning for space robotics developments and p 135 A87-40377 20 kHz Space Station power system p 76 A87-40378 On-board communications, including EVA A87-40380 p 85 On board Data Management p 112 A87-40381 The Space Station - Uses and users p 151 A87-40513 Robots on the Space Station p 100 A87-40844 Orbital modifications using forced tether-length p 124 A87-40858 variations A three-mass tethered system for micro-g/variable-g applications p 125 A87-40859 Resistojet control and power for high frequency ac buses [AIAA PAPER 87-09941 p 58 A87-41103 The Canadian Robotic System for the Space Station [AIAA PAPER 87-1677] p 100 A87-41153 Columbus/Space Station United Kingdom, Utilisation Study 1985/6 Report - Executive Summary The Space Station overview p 168 A87-41571 The single-stage reusable ballistic launcher concept for economic cargo transportation p 135 A87-41573 Dynamic analysis and experiment methods for a generic space station model p 22 A87-41613 Space Station opportunity for UK in earth sensing p 152 A87-41678 A model for the estimation of the operations and utilisation costs of an international space station p 168 A87-42267 Space station active thermal control system modelling [AIAA PAPER 87-1468] p 43 A87-43003 The benefit of phase change thermal storage for spacecraft thermal management [AIAA PAPER 87-1482] D 43 A87-43014 Evaluation of cryogenic system test options for the OTV on-orbit propellant depot [AIAA PAPER 87-1498] p.90 A87-43027 Liquid droplet radiator development status --- waste heat

rejection devices for future space vehicles

its effect on thermal control materials

The definition of the low earth orbital environment and

External contamination environment of Space Station

Thermal test results of the two-phase thermal bus

Development of a prototype two-phase thermal bus

p 43 A87-43059

p 43 A87-43103

p 52 A87-43122

p 44 A87-43125

p 44 A87-43126

[AIAA PAPER 87-1537]

[AIAA PAPER 87-1599]

[AIAA PAPER 87-1623]

[AIAA PAPER 87-1627]

system for Space Station

[AIAA PAPER 87-1628]

Customer Servicing Facility

technology demonstration loop

[AIAA PAPER 87-1767] p 91 A87-45191 Operation of the orbital spacecraft consumables resupply system (OSCRS) at the Space Station [AIAA PAPER 87-1768] p 135 A87-45192 Space Station options for constructing advanced solar sails capable of multiple Mars missions [AIAA PAPER 87-1902] p 91 A87-45287 Composite fiber/metal Space Station tankage Applications, material/process/design trades, subscale manufacturing/test results [AIAA PAPER 87-2157] p 160 A87-45441 FDMA system design and analysis for Space Station p 85 A87-45483 Feasibility study on 8PSK, QPSK, TFM, by using CLASS for Space Station/TDRSS real measured channel p 113 A87-45485 Multiple beam phased array for Space Station Control Zone Communications p 85 A87-45519 Space Station tracking subsystem sensor evaluation p 85 A87-45520 cost effective 300 Mbps space-to-ground communications subsystem for the Space Station p 113 A87-45521 End-to-end communications for Space Station p 85 A87-45522 Antenna systems and RF coverage for the Space Station p 2 A87-45523 Space Station multiple access communications p 86 A87-45524 GPS applications to the Space Station p 136 A87-45525 Man's role in space exploration and exploitation p 169 A87-46332 We shouldn't build the Space Station now p 169 A87-46875 The Space Station: A personal journey --- Book p 169 A87-46975 Space Station business p 169 A87-47726 Space Station - The next logical step p 169 A87-47868 The problem of radiation exposure in the Space Station [DGLR PAPER 86-175] p 153 A87-48157 Japanese customer needs for Space Station [AIAA PAPER 87-2193] p 153 A87-48580 Scientific user requirements for microgravity research (European aspects) [AIAA PAPER 87-2195] p 153 A87-48581 Scientific customer needs - NASA user [AIAA PAPER 87-2196] p 119 A87-48582 Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583 Data storage systems technology for the Space Station [AIAA PAPER 87-2202] p 113 A87-48587 Data capture and processing --- for Space Station [AIAA PAPER 87-22031 p 113 A87-48588 The Space Station software support environment - Not just what, but why [AIAA PAPER 87-2208] p 114 A87-48593 Standards for the user interface - Developing a user consensus --- for Space Station Information System
[AIAA PAPER 87-2209] p 169 A87-4 p 169 A87-48594 Integrated scheduling and resource management --- for Space Station Information System [AIAA PAPER 87-2213] p 119 A87-48597 Technical and Management Information System [AIAA PAPER 87-2217] D 114 A87-48600 Mission scheduling expert system and its space station applications [AIAA PAPER 87-2221] p 7 A87-48602 Space Station Information System integrated communications concept [AIAA PAPER 87-2228] p 114 A87-48606 Space Station Information System requirements for integrated communications [AIAA PAPER 87-2229] p 114 A87-48607 Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [AIAA PAPER 87-2120] p 93 A87-50197 Control/dynamics simulation for preliminary Space Station design [AIAA PAPER 87-2641] p 61 A87-50486 Proposed CMG momentum management scheme for [AIAA PAPER 87-2528] p 62 A87-50531 Linear quadratic control system design for Space Station pointed payloads [AIAA PAPER 87-2530] p 161 A87-50533

Space-based OTV boiloff disposition

The dynamics and control of the Space Station polar [AIAA PAPER 87-2600] p 62 A87-50562 An astrometric facility for planetary detection on the Space Station p 127 A87-50750 p 154 A87-50792 Space Station - All change? Development of a small-sized space manipulator p 101 A87-51979 Space Station gas-grain simulation facility - Application exobiology p 127 A87-53002 to exobiology Space Station autonomy - What are the challenges? How can they be met? p 101 A87-53059 Perspectives on materials processing in space [AAS PAPER 86-103] p 170 A87-53083 Operational instruments on the Space Station-Polar Platforms - Contributions by NOAA and the international community p 127 A simulation model for the analysis of Space Station gas-phase trace contaminants p 52 A87-53979 An advanced technology space station for the year 2025, study and concepts [NASA-CR-178208] p 120 N87-20340 Fire safety concerns in space operations [NASA-TM-89848] p 165 N87-20342 Advanced EVA system design requirements study: EVAS/space station system interface requirements [NASA-CR-171981] p 120 N87-20351 Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353 Resistojet control and power for high frequency ac [NASA-TM-89860] p 63 N87-20477 Space station structures and dynamics test program NASA-TP-2710] p 28 N87-20568 [NASA-TP-2710] Proceedings of the European Symposium on Polar platform Opportunities and Remote-Sensing (ESPOIR) Instrumentation [ESA-SP-2661 p 128 N87-20621 The Earth observation activities of the European Space Agency and the use of the polar platform of the International Space Station p 128 N87-20622 The Columbus program: An overview p 156 N87-20623 European utilization aspects studies --- space stations p 156 N87-20624 ESA Columbus polar platform design concept p 156 N87-20627 Servicing of the polar platform --- Columbus space p 136 N87-20628 Orbit configurations --- space station polar platform p 156 N87-20629 Payload data management scheme planned for Earth observation sensors to be flown on the polar platforms in the framework of the space station/Columbus p 114 N87-20630 Cooperation of the International Space Station partners in the preparation of the use of space station elements for Earth observation (platform and payload aspects) p 128 N87-20631 USA-Europe coordination and cooperation activities: Announcements of Opportunity --- polar platforms p 170 N87-20632 Land panel report --- International Space Station p 128 N87-20634 Ocean-ice panel report --- International Space Station p 156 N87-20635 Solid Earth panel report --- Columbus program p 157 N87-20636 Panel report on multidisciplinary instrumentation: New possibilities --- Columbus space station p 161 N87-20637 Panel report on new approaches to calibration and validation --- Columbus polar platforms p 157 N87-20638 Data management panel report --- Columbus polar platforms The orbit configuration panel report --- Columbus polar p 157 N87-20640 Panel report on the polar platform servicing approach and its implications --- Columbus space station p 136 N87-20641 Density uncertainty effect on cost of space station reboost p 170 N87-20667 Documentation of the space station/aircraft acoustic apparatus [NASA-TM-89111] p 140 N87-20795 An astrometric facility for planetary detection on the space station [NASA-TM-89436] p 128 N87-20841 The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the NASA IOC space station. Executive summary [NASA-CR-178276] p 8 N87-21020 Wave-mode coordinates and scattering matrices for wave propagation p 29 N87-21030

SPACE STATIONS
Space station experiment definition: Long term cryogenic
fluid storage p 94 N87-21144
Maintenance evaluation for space station liquid
systems p 52 N87-21155
Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585
[NASA-CR-4010] p 165 N87-21585 Space stations and the law: Selected legal issues
[PB87-118220] p 171 N87-21754
Plans for industrialization of space discussed
p 157 N87-21979
Equations of motion of a space station with emphasis
on the effects of the gravity gradient [NASA-TM-86588] p 64 N87-21993
The multi-disciplinary design study. A life cycle cost
algorithm
[NASA-CR-178192] p 9 N87-21995
Space station electric power system requirements and
design [NASA-TM-89889] p 96 N87-22001
Coaxial tube array space transmission line
characterization
[NASA-TM-89864] p 96 N87-22003
EMC and power quality standards for 20-kHz power distribution
[NASA-TM-89925] p 78 N87-22004
Application of a traction-drive 7-degrees-of-freedom
telerobot to space manipulation
[DE87-004616] p 101 N87-22231
Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233
Telerobotic technology for nuclear and space
applications
[NASA-CR-180923] p 102 N87-22242
Problems in merging Earth sensing satellite data sets [NASA-TM-87820] p 129 N87-22457
[NASA-TM-87820] p 129 N87-22457  Department of Housing and Urban
Development-independent agencies appropriations for
1988
[GPO-73-418] p 171 N87-22560
Space Station/Shuttle Orbiter dynamics during
docking p 65 N87-22708  Considerations in the design and development of a
space station scale model p 9 N87-22711
Structural Dynamics and Control Interaction of Flexible
Structures
[NASA-CP-2467-PT-2] p 66 N87-22729 Impact of space station appendage vibrations on the
pointing performance of gimballed payloads
p 32 N87-22/33
Preliminary evaluation of a reaction control system for
the space station p 67 N87-22736  Dual keel space station control/structures interaction
study p 67 N87-22737
Slewing control experiment for a flexible panel
p 78 N87-22740
Crew activity and motion effects on the space station p 165 N87-22744
p 165 N87-22744 Space station structures and dynamics test program
p 33 N87-22751
Analytical determination of space station response to
crew motion and design of suspension system for
microgravity experiments p 67 N87-22752
Space station structural dynamics/reaction control system interaction study p 67 N87-22753
Adaptive momentum management for large space
structures
[NASA-CR-179085] p 67 N87-22758
Developing a voice-controlled, computer-generated
display to assist space station astronauts during maintenance activity
[AD-A178997] p 120 N87-22762
The effect of multipath on digital communications
systems: With application to space station
[AD-A178578] p 86 N87-22876
Performance characteristics of a combination solar
photovoltaic heat engine energy converter [NASA-TM-89908] p 78 N87-23028
A systems analysis of emergency escape and recovery
systems for the US space station
[AD-A179233] p 3 N87-23680
An analysis of space station motion subject to the
parametric excitation of periodic elevator motion
[70 /// 0200]
A multiple attribute decision analysis of manned airlock
systems [AD-A179241] p 137 N87-23682
Optimization of payload mass placement in a dual keel
space station
[NASA-TM-89051] p 68 N87-23687
Control considerations for high frequency, resonant,
power processing equipment used in large systems [NASA-TM-89926] p 68 N87-23690
Space station WP-04 power system. Volume 1:
Executive summary
[NASA-CR-179587-VOL-1] p 78 N87-23695
•

```
Space station WP-04 power system. Volume 2: Study
results
                                   p 79 N87-23696
[NASA-CR-179587-VOL-2]
  Preliminary performance characterizations of an
engineering model multipropellant resistojet for space
etation application
                                    p.96 N87-23821
[NASA-TM-100113]
  Application of advanced flywheel technology for energy
storage on space station
                                    p 68 N87-24028
[DE87-007657]
  Guidelines for noise and vibration levels for the space
                                   p 120 N87-24162
[NASA-CR-178310]
  National Aeronautics and Space Administration
Authorization Act
                                   p 171 N87-24240
[S-REPT-100-87]
  NASA/DOD Control/Structures Interaction Technology,
1986
                                    p 34 N87-24495
[NASA-CP-2447-PT-2]
  Space station: A program overview
                                   p 171 N87-24496
  Large space systems technology and requirements
                                     p 3 N87-24500
  Design, construction, and utilization of a space station
assembled from 5-meter erectable struts
                                    p 34 N87-24501
   Assessment of space station power system
                                    p 79 N87-24530
[ATES-AN-86/466]
                                                            system
  Status of series-resonant power conversion with high
internal frequencies. Support in definition of space station
 power interface
                                    p 79 N87-24533
 [ESA-CR(P)-2319]
 Space station experiment definition: Long-term cryogenic fluid storage
                                    p 97 N87-24641
 INASA-CR-40721
  Dynamic and thermal response finite element models
 of multi-body space structural configurations
                                    p 10 N87-24709
 [NASA-CR-178289]
                                   p 157
                                          N87-25031
   The Columbus program
   Ideas for educational physics experiments in space
                                   p 130 N87-25033
  Track and capture of the orbiter with the space station
 remote manipulator system
                                   p 137 N87-25339
 [NASA-TM-89221]
   Botanical payloads for platforms and space stations
                                   p 158 N87-25340
 [MBB-UR-E-921/86]
   Possibilities of the further development of Columbus to
 an autonomous European space station
                                    p 158 N87-25418
 [MRR-UR-F-922/86]
   Space station propulsion system technology
                                     p 97
                                           N87-25422
 INASA-TM-1001081
   Electrochemical processing of solid waste
                                   p 137 N87-25443
 [NASA-CR-181128]
   The Radarsat Modular Opto-electronic Multispectral
 Scanner (R-MOMS): A potential candidate for the Polar
 Orbiting Platform (POP) also
                                    p 130 N87-25506
 IMBB-UR-873/861
   Vapor fragrances
                                    n 165 N87-25561
 [NASA-CASE-LAR-13680-1]
   Collect lock joint for space station truss
                                     p 36 N87-25576
 [NASA-CASE-MSC-21207-1]
   Quick-disconnect inflatable se
                                 assembly
                                           N87-25583
                                    p 102
  (NASA-CASE-KSC-11368-11
   Preliminary design, analysis, and costing of a dynamic
  scale model of the NASA space station
                                     p 36 N87-25606
  [NASA-CR-4068]
   Contact dynamics math model
                                     p 71 N87-25801
  [NASA-CR-179147]
   Military man in space: A history of Air Force efforts to
  find a manned space mission
                                    p 171 N87-25815
  [AD-A179873]
    Space station systems: A bibliography with indexes
  (supplement 4)
                                       p 4 N87-26073
  [NASA-SP-7056(04)]
    Contamination assessment for OSSA space station IOC
  navloads
                                    p 141 N87-26082
  [NASA-CR-181165]
    Experimental evaluation of small-scale erectable truss
  hardware
                                      p 37 N87-26085
  [NASA-TM-89068]
    Contamination assessment for OSSA space station IOC
  navioads
                                      p 53 N87-26086
  NASA-CR-40911
    Hydrogen/oxygen economy for the
                                    space station
                                      p 98 N87-26130
    A 25-LBF gaseous oxygen/gaseous hydrogen thruster
                                      p 98 N87-26132
  for space station application
    Proven, long-life hydrogen/oxygen thrust chambers for
                                     p 98 N87-26133
  space station propulsion
    Water-propellant resistojets for
                                  man-tended platforms
                                     p 98 N87-26135
  [NASA-TM-100110]
    Space station electrical power system
                                      p 80 N87-26144
  [NASA-TM-100140]
    Design study of large area 8 cm x 8 cm wrapthrough
                                      p 80 N87-26424
  cells for space station
                                      p 80 N87-26447
    Space station power system
```

```
Control engineering tasks in the framework of the
Columbus program
[MBB-UR-E-912/86]
                                  n 158 N87-26842
  Development of an emulation-simulation thermal control
model for space station application
[NASA-CR-180312]
                                    n 45 N87-26936
  Military space station implications
                                   p 172 N87-26964
[AD-A180831]
  The undersea habitat as a space station analog:
Evaluation of research and training potential
                                    p 53 N87-27405
[NASA-CR-180342]
                 extravehicular
                                 hazards
                                           protection
  Space suit
development
                                    p 53 N87-27407
(NASA-TM-89355)
  SAGA: A project to automate the management of
  oftware production systems
                                    p 10 N87-27412
INASA-CR-1802761
  IKI department head on orbital power plants
                                   p 158 N87-27693
  Space station integrated wall design and penetration
damage control
                                    p 39 N87-28581
[NASA-CR-1791651
  Space station integrated wall design and penetration
damage control. Task 3: Theoretical analysis of penetration
[NASA-CR-179166]
  Space station integrated wall design and penetration
damage control. Task 4: Impact detection/location
                                      p 4 N87-28583
[NASA-CR-179167]
  Data management system architecture options for space
 stations --- Columbus project
                                    p 115 N87-28585
[SES/DNP/TR/002/85]
   Study of data management system architecture options
 for space station --- Columbus project
                                    p 115 N87-28586
[MATRA-RF/176/0932-ISS-1]
   Space station power semiconductor package
                                     p 81 N87-28825
 INASA-CR-1808291
                                     p 81 N87-28960
   The space station power system
   High power solar array technologies
                                     -- Columbus space
                                     p 82 N87-28976
   Organic Rankine cycle power conversion systems for page applications p 159 N87-28989
 space applications
   Automated Subsystem Control for Life Support System
 (ASCLSS)
                                     p 53 N87-29117
 NASA-CR-1720031
   Proceedings: Computer Science and Data Systems
  Technical Symposium, volume 1
                                    p 116 N87-29124
 NASA-TM-892851
   Engineering graphics and image processing at Langley
                                      p 10 N87-29129
 Research Center
   Proceedings: Computer Science and Data Systems
 Technical Symposium, volume 2 [NASA-TM-89286]
                                     p 116 N87-29144
   MAX: A space station computer option
                                    p 116 N87-29146
                                    p 116 N87-29149
   Information network architectures
                                     p 116 N87-29150
   Video image processing
               optics
                                    ngth
                                               division
   Fiber
                                     p 117 N87-29151
  multiplexing(components)
                                     p 117 N87-29152
   Fiber optic data systems
    Advanced local area network concepts
                                     p 117 N87-29153
   Testing and analysis of DOD Ada language products
                                     p 172 N87-29155
  for NASA
    User interface and payload command and control
                                      p 73 N87-29162
                                       p 4 N87-29163
    User data management
    Advanced software tools space
                                      station focused
p 5 N87-29164
  technology
                                     p 117 N87-29166
    Network operating system
    Network operating system focus technology
                                     p 117 N87-29167
    KSC Space Station Operations Language (SSOL)
                                     p 138
                                           N87-29168
    Optimizing experimental programs in operational
  planning of research carried out from spacecraft
                                     p 160 N87-29553
    Vibrations and structureborne noise in space station
                                      p 39 N87-29590
  [NASA-CR-181381]
    Space Station end effector strategy study
                                     p 103 N87-29593
  [NASA-TM-100488]
                                          for
                                options
    Space
             Station
                                     p 138 N87-29877
  docking/berthing
                                    actuator for Space
    An electromechanical attenuator
                                     p 138 N87-29878
  Station docking
                                      p 83 N87-29882
    Space Station alpha joint bearing
    JPL future missions and energy storage technology
                                      p 84 N87-29917
  implications
    Application of advanced flywheel technology for energy 
orage on space station p 74 N87-29933
  storage on space station
    National Aeronautics and Space Administration
                                     p 172 N87-30220
```

lightweight

N87-24508

SOBJECT INDEX	
NASA authorization: Authorization of appropriations for	Advanced technology experime
the National Aeronautics and Space Administration for	platform
fiscal year 1988 [GPO-73-245] p 172 N87-30221	Payload boomerang technology fo
[GPO-73-245] p 172 N87-30221 SPACE SUITS	at very low gravity level Optimization of a program of expen
A comparison between space suited and unsuited reach	with the operational planning of stud
envelopes p 47 A87-33013	a spacecraft
Space suit reach and strength envelope considerations	Thermal design of the ACCESS en
[SAE PAPER 860950] p 49 A87-38737	Space Station - Opportunities for the
Desirability of arms-in capability in space suits	•
[SAE PAPER 860951] p 49 A87-38738	Status of the RITA - Experiment or
An evaluation of options to satisfy Space Station EVA	Frequency Ion Thrustor Assembly [AIAA PAPER 87-0988]
requirements [SAE PAPER 861008] p 134 A87-38780	Electrodynamic plasma motor/g
[SAE PAPER 861008] p 134 A87-38780 An evaluation of advanced extravehicular crew	[AAS PAPER 86-210]
enclosures	Science and payload options to
[SAE PAPER 861009] p 134 A87-38781	research accommodations aboard Station
Human factors in space station architecture 2. EVA	[SAE PAPER 860953]
access facility: A comparative analysis of 4 concepts for on-orbit space suit servicing	Life Support Subsystem conce
[NASA-TM-86856] p 52 N87-24064	experiments of long duration
Space suit extravehicular hazards protection	[SAE PAPER 860967] Life Sciences Research Fa
development	requirements and concepts for the Sp
[NASA-TM-89355] p 53 N87-27407	[SAE PAPER 860970]
SPACE TOOLS End effector development study, volume 1 in-orbit	Plant and animal accommodation Laboratory
servicing	(SAE PAPER 8609751
[FOK-TR-R-86-091-VOL-1] p 102 N87-25336	On-orbit cryogenic fluid managemen
SPACE TRANSPORTATION	requirements using referee fluids
National space transportation studies [SAE PAPER 861681] p 160 A87-32598	[AIAA PAPER 87-1559] Scientific user requirements for mi
On the dynamical stability of the space 'monorail'	(European aspects)
p 148 A87-34047	[AIAA PAPER 87-2195]
The SERVICE concept p 134 A87-36362	Ram ion scattering caused by Sp
Trends in space transportation p 168 A87-41572 The Soviet space shuttle programme	induced differential charging
p 153 A87-47302	Space Station gas-grain simulation to exobiology
Leadership in space transportation	Human capabilities in space
p 170 A87-53989	[AAS PAPER 86-114]
The astronaut and the robot - Short- and long-term scenarios for space technology p 101 A87-53991	Microgravity experiments onboard E
National Aeronautics and Space Administration	From Eureca-A to Eureca-B
p 172 N87-30220	Analytical determination of space s
SPACE TRANSPORTATION SYSTEM	crew motion and design of suspe
System and operation analyses of OTV Network - A new space transportation concept p 145 A87-32475	microgravity experiments Space station experiment defi
System level verification applying the Space Shuttle	cryogenic fluid storage
experience to the Space Station	[NASA-CR-4072]
[AAS PAPER 86-001] p 55 A87-32727 Liquid propulsion technology for expendable and STS	Ideas for educational physics experi
launch vehicle transfer stages	Botanical payloads for platforms a
[AIAA PAPER 87-1934] p 92 A87-45311	[MBB-UR-E-921/86]
NERVA derived nuclear orbit transfer system	Review of Low Earth Orbital (LEO) f
[AIAA PAPER 87-2155] p 92 A87-45439 Space operations: NASA's use of information	
Space operations: NASA's use of information technology, Report to the Chairman, Committee on	Material interactions with the Low E environment: Accurate reaction rate me
Science, Space and Technology	environment. Accurate reaction rate me
[GAO/IMTEC-87-20] p 137 N87-22551	Mass spectrometers and atomic oxy
Department of Housing and Urban Development-independent agencies appropriations for	, i
1988	Interaction of hyperthermal atoms or
[GPO-73-418] p 171 N87-22560	The University of Alabama experiment
National Aeronautics and Space Administration Authorization Act	NASA Marshall Space Flight Cente
[S-REPT-100-87] p 171 N87-24240	investigations
Military man in space. A history of Air Force efforts to	Effect of long-term exposure to Low
find a manned space mission	space environment p
[AD-A179873] p 171 N87-25815	Expansion of space station diagnomic include serological identification of vir
Design of a mixed fleet transportation system to low Earth orbit. Volume 1: Executive summary. Volume 2:	infections
Near-term shuttle replacement. Volume 3: Heavy-lift cargo	Service Manipulator Arm (SMA) for a
vehicle. Volume 4: Advanced technology shuttle	Experiment (ROSE)
replacement p 5 N87-29583 NASA authorization: Authorization of appropriations for	[ESA-CR(P)-2347] p
the National Aeronautics and Space Administration for	Test results from the solar array flight
nscal year 1988	SPACEBORNE TELESCOPES
[GPO-73-245] p 172 N87-30221	Configuration tradeoffs for the space i
SPACEBORNE ASTRONOMY The Signe II gamma-ray burst experiment aboard the	facility pointing control system p
Prognoz 9 satellite p 150 A87-38443	Astrometric telescope of ten microard
The Space Station - Uses and users	on the Space Station p
p 151 A87-40513	Measuring thermal expansion in I structures for spaceborne telescopes
'HEXE' - X-ray observatory in space p 155 A87-53558	io spaceborne telescopes
P 155 A87-53558 SPACEBORNE EXPERIMENTS	Optical arrays for future astronomical
Gas and water recycling system for IOC vivarium	space p
experiments Initial Operational Capacity	Control of multiple-mirror/flexible-s
p 46 A87-32457 Preliminary results of CHARGE-2 tethered payload	maneuvers [AIAA PAPER 87-2324]
experiment p 121 A87-32521	An astrometric facility for planetary
Development of exposed deck of Japanese experiment	Space Station p

Solar concentrator system for experiments in the Space

Station

p 145 A87-32532

p 146 A87-32535

space station

[NASA-TM-89436]

```
ent onboard space
                                                                  Astronomic Telescope Facility: Preliminary systems
                                      p 122 A87-32536
                                                                definition study report. Volume 2: Technical description
                                    or space experiments
                                                                [NASA-TM-89429-VOL-2]
                                                                                                  p 129 N87-22570
                                      n 146 A87-32540
                                                                  Astrometric Telescope Facility preliminary systems
                                     riments in connection
                                                               definition study. Volume 1: Executive summary
                                     idies carried out with
                                                                                                   p 129 N87-22571
                                      p 148 A87-34208
                                                              SPACECRAFT ANTENNAS
                                     rectable space truss
                                                                  Robust controller synthesis for a large flexible space
                                       p 42 A87-34469
                                                                                                    p 84 A87-32235
                                                                antenna
                                    the life sciences
                                                                  On a balanced passive damping and active vibration
                                      p 122 A87-34871
                                                                suppression of large space structures
                                    on EURECA --- Radio
                                                               [AIAA PAPER 87-0901]
                                                                                                    p 19 A87-34701
                                                                  Composite space antenna structures - Properties and
                                      p 123 A87-38002
                                                                environmental effects
                                                                                                    p 20 A87-38610
                                    generator experiment
p 89 A87-38569
                                                                  The evolution of the geostationary platform concept
                                                                                                   p 125 A87-43154
                                       animal and plant
                                                                  Antenna systems and RF coverage for the Space
                                    the early Space
                                                               Station
                                                                                                     p 2 A87-45523
                                                                 Evaluation of the built-in stresses and residual distortions
                                      p 164 A87-38740
                                                               on cured composites for space antenna reflectors
                                    cepts for botanical
                                                               applications
                                                                                                    p 22 A87-47327
                                                                  On-line identification and attitude control for SCOLE
                                       p 49 A87-38749
                                                               [AIAA PAPER 87-2459]
                                                                                                   p 61 A87-50505
                                    acility
                                            automation
                                                                 Large space antennas: A systems analysis case
                                    Space Station
                                       p 50 A87-38752
                                                               [NASA-TM-89072]
                                                                                                   p 26 N87-20352
                                     for Space Station
                                                                 Stress and deformation analysis
                                                                                                     of
                                                               composite structures --- space antennas
                                      p 124 A87-38757
                                                               MBB-UD-489/861
                                                                                                   p 30 N87-22269
                                    ent experimental data
                                                                 Robust control for large space antennas
                                                                                                   p 87 N87-24499
                                       p 90 A87-44832
                                                                 Antenna Technology Shuttle Experiment (ATSE)
                                    nicrogravity research
                                                                                                   p 87
                                                             SPACECRAFT CABIN ATMOSPHERES
                                     p 153 A87-48581
                                                                 An evolutionary approach to the development of a
                                    Space Shuttle v x B
p 140 A87-51713
                                                               CELSS based air revitalization system
                                                               [SAE PAPER 860968]
                                                                                                   n 49 A87-38750
                                     facility - Application
                                                                 An advanced carbon reactor subsystem for carbon
                                     p 127 A87-53002
                                                               dioxide reduction
                                                               [SAE PAPER 860995]
                                                                                                   p 51 A87-38772
                                     p 165 A87-53089
                                                             SPACECRAFT CABIN SIMULATORS
                                    Eureca
                                                                A simulation model for the analysis of Space Station
                                     p 155
                                            A87-53554
                                                               gas-phase trace contaminants
                                                                                                   p 52 A87-53979
                                            A87-53916
                                     p 155
                                                            SPACECRAFT CABINS
                                    station response to
                                                                Analysis of crew functions as an aid in Space Station
                                    ension system for
                                                               interior layout
                                      p 67
                                                              [SAE PAPER 860934]
                                                                                                  p 163 A87-38724
                                    finition:
                                            Long-term
                                                            SPACECRAFT CHARGING
                                                                Spacecraft dielectric material properties and spacecraft
                                      p 97 N87-24641
                                                              charging --- Book
                                                                                                  p 105 A87-33100
                                    riments in space
p 130 N87-25033
                                                                Potential modulation on the SCATHA spacecraft
                                                                                                  p 138 A87-34460
                                     and space stations
                                                                Modeling of environmentally induced transients within
                                     p 158 N87-25340
                                                              satellites
                                     flight experiments
                                                              [AIAA PAPER 85-0387]
                                                                                                    p 7 A87-41611
                                    p 131 N87-26174
                                                                Ram ion scattering caused by Space Shuttle v x B
                                     .
Earth Orbital (LEO)
                                                              induced differential charging p 140 A87-51713
Potential modulations on SCATHA (Spacecraft Charging
                                     neasurements
                                    p 108 N87-26175
                                                              At High Altitude) spacecraft
                                    vaen
                                                              [AD-A176815]
                                                                                                 p 140 N87-21024
                                    p 141 N87-26176
                                                                The Aerospace Environment at High Altitudes and its
                                                              Implications
                                    on surfaces in orbit:
                                                                          for
                                                                                   Spacecraft
                                                                                                  Charging
                                                              Communications
                                                              [AGARD-CP-406]
                                    p 108 N87-26177
                                                                                                 p 142 N87-26937
                                                                The use of Pi2 pulsations as indicators of substorm
                                    er atomic oxygen
                                                               ffects at geostationary orbit p 142 N87-26942
Spacecraft charging in the auroral plasma: Progress
                                                              effects at geostationary orbit
                                    p 109 N87-26202
                                     Earth Orbit (LEO)
                                                              toward understanding the physical effects involved
                                    p 142 N87-26207
                                                                                                p 142 N87-26949
                                     nostic capability to
                                                                Arc propagation, emission and damage on spacecraft
                                     iral and bacterial
                                                              dielectrics
                                                                                                 p 143 N87-26952
                                     p 53 N87-26703
                                                                On the possibility of a several-kilovolt differential charge
                                     a Robotic Servicing
                                                              in the day sector of a geosynchronous orbit
                                                                                                 p 158 N87-26953
                                    p 103 N87-28260
                                                                Radiation charging and breakdown of insulators
                                    ht experiment
                                                                                                 p 143 N87-26954
                                     p 83 N87-29010
                                                               Electrostatic immunity of geostationary satellites
                                                                                                p 143 N87-26957
                                     infrared telescope
                                                               Surface modification to minimise the electrostatic
                                    p 121 A87-32236
                                                             charging of Kapton in the space environment
                                                                                                 p 87 N87-26959
                                    resecond accuracy
                                                               Automatic charge control system for geosynchronous
                                    p 122 A87-35222
                                     large composite
                                                             satellites
                                                                                                 p 87
                                                               Thick dielectric charging on high altitude spacecraft
                                     p 20 A87-38612
                                                                                                 p 87 N87-26961
                                                               Documentation for the SHADO particle wake routine
                                     al telescopes in
                                                                                                p 131 N87-26967
                                     126 A87-44533
                                                               Stopping differential charging of solar arrays
                                    structures in slew
                                                                                                 p 83 N87-28984
                                                           SPACECRAFT COMMUNICATION
                                    p 24 A87-50445
                                                               Multiple Access Ku-band communications subsystem for
  An astrometric facility for planetary detection on the
                                                             the Space Station
                                                                                                 p 84 A87-31462
Space Station
                                   p 127 A87-50750
                                                              Japanese experiment module data management and
  An astrometric facility for planetary detection on the
                                                             communication system
                                                                                                D 147 A87-32542
```

p 128 N87-20841

p 134 A87-37297

Space Station communications and tracking system

Variable structure controller design for spacecraft

Star topology spacecraft data bus	International SAMPE Technical Conference, 18th,
p 112 A87-37431	Seattle, WA, Oct. 7-9, 1986, Proceedings p 167 A87-38576
Communication and Data Management Systems for an orbiting platform p 112 A87-40359	Effect of long-term exposure to LEO space environment
On-board communications, including EVA	on spacecraft materials p 106 A87-39426
p 85 A87-40380	Microcrack resistant structural composite tubes for space applications p 106 A87-41022
FDMA system design and analysis for Space Station p 85 A87-45483	space applications p 106 A87-41022  The definition of the low earth orbital environment and
Feasibility study on 8PSK, QPSK, TFM, by using CLASS	its effect on thermal control materials
for Space Station/TDRSS real measured channel	[AIAA PAPER 87-1599] p 43 A87-43103
p 113 A87-45485 Multiple beam phased array for Space Station Control	Materials for space applications p 106 A87-44741
Zone Communications p 85 A87-45519	Development of full scale deployable CFRP truss for space structure p 25 A87-51793
End-to-end communications for Space Station	space structure p 25 A87-51793  Future trends in spacecraft design and qualification
p 85 A87-45522 Space Station multiple access communications	p 2 N87-20356
Space Station multiple access communications system p 86 A87-45524	Oxidation protection coatings for polymers
Japanese customer needs for Space Station	[NASA-CASE-LEW-14072-3] p 107 N87-23736
[AIAA PAPER 87-2193] p 153 A87-48580	Fiber composites in satellites [MBB-UD-492/86] p 107 N87-25430
Data capture and processing for Space Station [AIAA PAPER 87-2203] p 113 A87-48588	An electrically conductive thermal control surface for
The Consultative Committee for Space Data Systems	spacecraft encountering Low-Earth Orbit (LEO) atomic
Standards program	oxygen indium tin oxide-coated thermal blankets p 45 N87-26192
[AIAA PAPER 87-2204] p 113 A87-48589 Data management standards for space information	An evaluation of candidate oxidation resistant
systems	materials p 110 N87-26203
[AIAA PAPER 87-2205] p 113 A87-48590	Radiation charging and breakdown of insulators p 143 N87-26954
Space Station Information System integrated	SPACECRAFT CONTAMINATION
communications concept [AIAA PAPER 87-2228] p 114 A87-48606	Enhancement of solar absorptance degradation due to
Space Station Information System requirements for	contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory
integrated communications	measurements p 144 A87-32346
[AIAA PAPER 87-2229] p 114 A87-48607 Measurement apparatus and procedure for the	Effects of varying environmental parameters on trace
determination of surface emissivities	contaminant concentrations in the NASA Space Station
INASA CASE AR-13455-11 D 29 N87-21206	Reference Configuration (SAF PAPER 860916) p 47 A87-38708
The Aerospace Environment at High Altitudes and its	[SAE PAPER 860916] p 47 A87-38708 External contamination environment of Space Station
Implications for Spacecraft Charging and Communications	Customer Servicing Facility
[AGARD_CP-406] p 142 N87-26937	[AIAA PAPER 87-1623] p 52 A87-43122
User interface and payload command and control p 73 N87-29162	A simulation model for the analysis of Space Station gas-phase trace contaminants p 52 A87-53979
SPACECRAFT COMPONENTS	Resistojet plume and induced environment analysis
International SAMPE Technical Conference, 18th,	INASA-TM-889571 D 96 NB/-24536
Seattle, WA, Oct. 7-9, 1986, Proceedings p 167 A87-38576	Contamination assessment for OSSA space station IOC payloads
Materials for space applications p 106 A87-36370	INASA_CR_1811651 p 141 N87-26082
Dynamic analysis of the flexible boom in the N-ROSS	Contamination assessment for OSSA space station IOC
eatellite	payloads [NASA-CR-4091] p 53 N87-26086
[AD-A181488] p 72 N87-26966 Computer simulation of a rotational single-element	SPACECRAFT CONTROL
flevible spacecraft boom	Use of beads-up displays, speech recognition, and
[AD.A181798] D 103 N87-26968	speech synthesis in controlling a remotely piloted space
Effects on advanced materials: Results of the STS-8 EOIM (Effects of Oxygen Interaction with Materials)	Evnert systems in space p 111 A87-32075
experiment	Robust controller design using frequency domain
(AD-A182931) p 110 N87-29709	constraints p 11 A87-32229 A review of modelling techniques for the open and
SPACECRAFT CONFIGURATIONS	closed-loop dynamics of large space systems
Mechanical design of the Eurostar platform p 149 A87-34874	p 12 A87-32337
Tethers in space: Proceedings of the International	Local control for large space structures p 54 A87-32440
Conference, Arlington, VA, Sept. 17-19, 1986 p 123 A87-38567	Flexibility control of torsional vibrations of a large solar
Mass property estimation for control of a symmetrical	array p 12 A87-32442
estellites D 63 A87-52906	Two-time-scale design of robust controllers for large
Modal testing of the Olympus development model	structure systems p 12 A87-32443 A preliminary study on a linear inertial actuator for LSS
stowed solar array p 27 N87-20366 Variable structure control system maneuvering of	pontrol D 55 A87-32447
enacoraft D 64 N87-21989	Control of flexible solar arrays with consideration of the
Impact of space station appendage vibrations on the	actuator dynamics of the reaction wheel
pointing performance of gimballed payloads p 32 N87-22733	Control of a flexible space manipulator
Preliminary evaluation of a reaction control system for	р 99 А87-32449
the space station p 67 N87-22736	Guidance and control 1986; Proceedings of the Annual
The space station power system p 81 N87-28960	Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 p 55 A87-32726
Status of space station power system p 84 N87-29915	Low-authority control through passive damping
SPACECRAFT CONSTRUCTION MATERIALS	[AAS PAPER 86-004] p 55 A87-32730
A space debris simulation facility for spacecraft materials	A highly adaptable steering/selection procedure for combined CMG/RCS spacecraft control
evaluation p 11 A87-32058 The Vanderbilt University neutral O-beam facility	[AAS PAPER 86-036] p 56 A87-32/41
p 105 A87-32059	Aeroassist flight experiment guidance, navigation and
High intensity 5 eV CW laser sustained 0-atom exposure	control [AAS PAPER 86-042] p 133 A87-32744
facility for material degradation studies p 105 A87-32060	System architecture for the telerobotic work system
Selected materials issues associated with Space	TARC DADED 86_044\ D 99 A87-32746
Station 0 105 A87-32001	Experience in distributed parameter modeling of the
Spacecraft dielectric material properties and spacecraft	Spacecraft Control Laboratory Experiment (SCOLE)
charging Book p 105 A87-33100 Computerized aerospace materials data; Proceedings	structure [AIAA PAPER 87-0895] p 16 A87-33689
of the Workshop on Computerized Property Materials and	the state of denominal model by uncertain
Design Data for the Aerospace Industry, El Segundo, CA,	Adaptive tracking of dynamical model by uncertain
Design Data for the Acrospess masses,	nonlinearizable spacecraft
June 23-25, 1986 P 111 A87-35282	nonlinearizable spacecraft (AIAA PAPER 87-0940) p 57 A87-33738
June 23-25, 1986 p 111 A87-35282 Comparison of satellite support structure aluminum versus graphite epoxy	nonlinearizable spacecraft

p 20 A87-36279

p 58 A87-39958 nutation damping Deployment dynamics of space structures A87-40074 Interdisciplinary analysis procedures in the modeling and control of large space-based structures p 22 A87-42678 Actuators for actively controlled space structures p 59 A87-42816 Robust nonlinear attitude control of flexible spacecraft p 60 A87-48273 AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volumes 1 & 2 p 60 A87-50401 p 60 A87-50401 Construction of positive real compensation for LSS control --- applied to Large Space Structure model p 60 A87-50404 [AIAA PAPER 87-2238] Low-authority control of large space structures by using tendon control system p 60 A87-50413 [AIAA PAPER 87-2249] Robust control of a large space antenna p 86 A87-50417 [AIAA PAPER 87-2253] A laboratory simulation of flexible spacecraft control p 24 A87-50446 [AIAA PAPER 87-2325] An analytical and experimental investigation of output feedback vs. linear quadratic regulator --- for large space p 61 A87-50474 [AIAA PAPER 87-2390] Comparison of different attitude control schemes for large communications satellites p 61 A87-50475 [AÏAA PAPER 87-2391] Control/dynamics simulation for preliminary Space Station design p 61 A87-50486 [AIAA PAPER 87-2641] Practical issues in computation of optimal, distributed control of flexible structures p 25 A87-50507 [AIAA PAPER 87-2461] Adaptive momentum management for the dual keel Space Station [AIAA PAPER 87-2596] p 62 A87-50558 The dynamics and control of the Space Station polar p 62 A87-50562 [AIAA PAPER 87-2600] Mass property estimation for control of asymmetrical p 63 A87-52968 satellites Propellant tank resupply system p 93 N87-20375 [AD-D012559] Space station momentum management p 64 N87-20668 Space station control moment gyro control p 64 N87-20669 Aero-Assisted Orbital Transfer Vehicle (AOTV) p 3 N87-20682 Variable structure control system maneuvering of p 64 N87-21989 spacecraft Structural Dynamics and Control Interaction of Flexible Structure p 65 N87-22702 [NASA-CP-2467-PT-1] p 30 N87-22703 Status of the Mast experiment Microprocessor controlled proof-mass actuator p 65 N87-22706 Considerations in the design and development of a p 9 N87-22711 space station scale model Optimum mix of passive and active control of space p 65 N87-22714 structures Status report and preliminary results of the spacecraft p 66 N87-22717 control laboratory experiment p 66 N87-227
Precision pointing and control of flexible spacecraft p 66 N87-22723 Control of flexible structures and the research p 66 N87-22732 community Moving-bank multiple model adaptive estimation applied to flexible spacestructure control [AD-A178870] p 68 N87-22761 NASA/DOD Control/Structures Interaction Technology, 1986 p 34 N87-24495 [NASA-CP-2447-PT-2] Large spacecraft pointing and shape control p 69 N87-24498 Robust control for large space antennas p 87 N87-24499 Large space systems technology and requirements p 3 N87-24500 Controls-structures-electromagnetics interaction p 69 N87-24502 program Application of physical parameter identification to p 34 N87-24505 finite-element models COFS 3 multibody dynamics and control technology p 69 N87-24506 Control technology overview in CSI p 69 N87-24507 Structural control by the use of piezoelectric active p 69 N87-24509 Ground test of large flexible structures p 34 N87-24510

(SAWE PAPER 1692)

[NASA-CR-180920]

of nonlinear controls

Slew maneuvers on the SCOLE Laboratory Facility	Investigation for damping design and re
p 69 N87-24511 Research in slewing and tracking control	vibrations of spacecraft structures [EMSB-64/85] p;
p 70 N87-24512 Evaluation of on-line pulse control for vibration	Assessment of space station power sys [ATES-AN-86/466] p 7
suppression in flexible spacecraft [NASA-CR-180391] p 70 N87-24513	System technology analysis of aero transfer vehicles. Moderate lift/drag (0.75-1
Proceedings of the Second International Symposium on	part 1: Executive summary, phase 1
Spacecraft Flight Dynamics [ESA-SP-255] p 171 N87-25354	[NASA-CR-179139] p § System technology analysis of aeroas
The effects of structural perturbations on decoupled	transfer vehicles. Moderate lift/drag (0.75-1
Automatic docking maneuver and attitude control s	part 2: Executive summary, phase 2 [NASA-CR-179140] p
ystem p 71 N87-25395 Proceedings: Computer Science and Data Systems	System technology analysis of aeros transfer vehicles: Moderate lift/drag (0.75-
Technical Symposium, volume 2	Cost estimates and work breakdown struct
[NASA-TM-89286] p 116 N87-29144 SPACECRAFT DESIGN	phase 1 and 2 [NASA-CR-179144] p
Space launcher upper stages - Design for mission versatility and/or orbital operation p 132 A87-32474	System technology analysis of aeroas transfer vehicles: Moderate lift/drag (0.75-
Design of a polar platform with an earth observation	Supporting research and technology repor
payload p 122 A87-32538 Concept design and cost estimation of a free-flying	2 [NASA-CR-179143] p
space platform p 146 A87-32539 Simultaneous structure/control optimization of large	System technology analysis of aeroa
flexible spacecraft	transfer vehicles: Moderate lift/drag (0.75-1. part 2, study results
[AIAA PAPER 87-0823] p 14 A87-33610 Optimization procedure to control the coupling of	[NASA-CR-179142] p Development of experimental/analytical
vibration modes in flexible space structures	structural design verification spacecraft
Structural and control optimization of space structures	[ESA-CR(P)-2340] p 3 Design and demonstrate the performance
[AIAA PAPER 87-0939] p 17 A87-33737 Analysis of crew functions as an aid in Space Station	components representative of space vehicle liquid acquisition device performance analy
interior layout	[NASA-CR-179138] p 9
[SAE PAPER 860934] p 163 A87-38724 Concepts for the evolution of the Space Station	USSR Report: Space [JPRS-USP-86-004] p 158
Program [SAE PAPER 860972] p 120 A87-38754	Pravda commentary, photos of Mir orbita
Evaluation of Space Station thermal control	p 158 Status of space station power system
techniques [SAE PAPER 860998] p 42 A87-38775	p 84 SPACECRAFT DOCKING
Application of reanalysis techniques in dynamic analysis of spacecraft structures p 21 A87-38824	Rendezvous and docking tracker [AAS PAPER 86-014] p 133
Advanced technology for the Space Station	Laser docking system flight experiment
p 120 A87-40353 An integrated approach to spacecraft design for robotic	[AAS PAPER 86-043] p 99 Control of an autonomous spacecraft rei
servicing [AIAA PAPER 87-1672] p 100 A87-41152	docking maneuver by means of image proc [DGLR PAPER 86-122] p 101
Design parameters and environmental considerations for a reusable aeroassisted orbital transfer vehicle	Developing Space Station. II - Power
[AIAA PAPER 87-1505] p 160 A87-43031	docking and remote sensing are important the Space Station p 127
Development of a prototype two-phase thermal bus system for Space Station	Space Station/Shuttle Orbiter dyna docking p 65
[AIAA PAPER 87-1628] p 44 A87-43126 The Earth Observing System (EOS) synthetic aperture	Attitude and Orientation System (AOC Rendezvous and Docking (RVD) (docki
radar (SAR) p 126 A87-44187	phases). Architecture of the whole simular
Liquid propulsion technology for expendable and STS launch vehicle transfer stages	[LP-RP-Al-204-VOL-2] p 68 Attitude and Orientation Control System (
[AIAA PAPER 87-1934] p 92 A87-45311 An approach to structure/control simultaneous	on Rendezvous and Docking (RVD) (docking phases). Simulation set-up and results, volume
optimization for large flexible spacecraft	[LP-RP-Al-204-VOL-3] p 69
p 22 A87-46793 Space Station - The next logical step	Attitude and Orientation Control System ( on Rendezvous and Docking (RVD) (docking
p 169 A87-47868 Square root state estimator for large space structures	phases). Docking-undocking phase analysis [LP-RP-Al-204-VOL-1] p 70
[AIAA PAPER 87-2389] p 24 A87-50473 Control/dynamics simulation for preliminary Space	Track and capture of the orbiter with the s
Station design	[NASA-TM-89221] p 137
Structure and design of spacecraft Russian book	Automatic docking maneuver and attitude ystem p 71
p 155 A87-51870 From Eureca-A to Eureca-B p 155 A87-53916	Preloadable vector sensitive latch
Future trends in spacecraft design and qualification	Contact dynamics math model
P 2 N87-20356 Recent developments and future trends in structural	[NASA-CR-179147] p 71 Rendezvous and docking (RVD) long rang
dynamic design verification and qualification of large flexible spacecraft p 156 N87-20357	definition study, executive summary
Dynamic modeling and optimal control design for large	The preloadable vector sensitive latel
Effect of modal damping in modal synthesis of spacecraft	docking/berthing p 162 Space Station based options f
structures p 26 N87-20362 Benefits of passive damping as applied to active control	docking/berthing p 138
of large space structures p 63 N87-20371 Upper and Middle Atmospheric Density Modeling	An electromechanical attenuator/actuator Station docking p 138
Requirements for Spacecraft Design and Operations	SPACECRAFT ELECTRONIC EQUIPMENT
[NASA-CP-2460] p 64 N87-20665 Orbital transfer vehicle concept definition and system	An integrated analytic tool and knowledge-ba approach to aerospace electric power sys
analysis study. Volume 1A: Executive summary. Phase 2	[SAE PAPER 861622] p 74  SPACECRAFT ENVIRONMENTS
The multi-disciplinary design study. A life cycle cost	ISOKIN - A quantitative model of the kinesth
algorithm [NASA-CR-178192] p 9 N87-21995	of spatial habitability p 162 Human performance in space p 162
Soviet space stations as analogs, second edition	Human factors standards for space habitati

p 157 N87-21996

p 66 N87-22731

A quasi-analytical method for non-iterative computation

```
elated nonlinear
                                                                 Space Station environmental control and life support
                                                               system distribution and loop closure studies
                                         35 N87-24516
                                                               [SAE PAPER 860942]
                                                                                                     p 48 A87-38729
                                         tem
                                                                 Status of the Space Station environmental control and
                                         79 N87-24530
                                                               life support system design concept
[SAE PAPER 860943]
                                         assisted orbital
                                                                                                     n 48 A87-38730
                                          .5). Volume 1A,
                                                                 Environmental Control Life Support for the Space
                                                               Station
                                         7 N87-26062
                                                               [SAE PAPER 860944]
                                                                                                     p 48 A87-38731
                                         ssisted orbital
                                                                 Integrated air revitalization system for Space Station
                                         .5): Volume 1A,
                                                               ISAE PAPER 8609461
                                                                                                    p 48 A87-38733
                                                                 Results on reuse of reclaimed shower water
                                         3 N87-26063
                                                               [SAE PAPER 860983]
                                                                                                    p 50 A87-38762
                                         assisted orbital
                                                                 A membrane-based subsystem for very high recoveries
                                                               of spacecraft waste waters
                                         ture/dictionary,
                                                               [SAE PAPER 860984]
                                                                                                    p 50 A87-38763
                                                                 Development of a water recovery subsystem based on
                                         3 N87-26064
                                                               Vapor Phase Catalytic Ammonia Removal (VPCAR)
                                         sisted orbital
                                                               [SAE PAPER 860985]
                                                                                                    p 50 A87-38764
                                         1.5). Volume 2:
                                                                 Environmental control and life support technologies for
                                         t phase 1 and
                                                               advanced manned space missions
                                                               [SAE PAPER 860994]
                                                                                                    p.51 A87-38771
                                         3 N87-26065
                                                                 Control/monitor instrumentation for environmental
                                         esisted orbital
                                                               control and life support systems aboard the Space
                                         .5), Volume 1B,
                                                              [SAE PAPER 861007]
                                                                                                    p 52 A87-38779
                                         4 N87-26067
                                                                 Effect of long-term exposure to LEO space environment
                                          concepts for
                                                              on spacecraft materials
                                                                                                  p 106 A87-39426
                                         structures
                                                                 Spacecraft environment interaction investigation
                                         6 N87-26075
                                                              [AD-A179183]
                                                                                                  p 140 N87-23678
                                         e of cryogenic
                                                                Resistojet plume and induced environment analysis
                                         s: Start basket
                                                              [NASA-TM-88957]
                                                                                                   p 96 N87-24536
                                                                Development of an emulation-simulation thermal control
                                          N87-26081
                                                              model for space station application [NASA-CR-181009]
                                                                                                    p 45 N87-26072
                                         8 N87-27687
                                                                Active vibration control in microgravity environment
                                         station
                                                                                                   p 72 N87-26700
                                         8 N87-27688
                                                                Space stable thermal control coatings
                                                              [AD-A182796]
                                                                                                  p 110 N87-28584
                                         4 N87-29915
                                                                Space station propulsion-ECLSS interaction study
                                                              [NASA-CR-175093]
                                                                                                   p 54 N87-29594
                                                                A microgravity isolation mount
                                                                                                  p 161 N87-29861
                                         3 A87-32733
                                                            SPACECRAFT EQUIPMENT
                                                                Development of fluid loop system for spacecraft
                                         AR7-32745
                                                                                                  p 144 A87-32370
                                                                A master-slave manipulator system for space use p 147 A87-32546
                                         ndezvous and
                                         essing
1 A87-48156
                                                           SPACECRAFT GLOW
                                          rendezvous.
                                                               Groundbased studies of spacecraft glow and erosion
                                                             caused by impact of oxygen and nitrogen beams
                                           A87-54198
                                                                                                 p 109 N87-26200
                                         mics during
                                                           SPACECRAFT GUIDANCE
                                           N87-22708
                                                               Guidance and control 1986; Proceedings of the Annual
                                         S) tasks on
                                                              Rocky Mountain Guidance and Control Conference,
                                         ng-undocking
                                                             Keystone, CO, Feb. 1-5, 1986
                                                                                                  p 55 A87-32726
                                         tor, volume 2
                                                               System level verification applying the Space Shuttle
                                          N87-24490
                                                             experience to the Space Station
                                         (AOCS) tasks
                                                             [AAS PAPER 86-001]
                                                                                                   D 55 A87-32727
                                         ng-undocking
                                                               Aeroassist flight experiment guidance, navigation and
                                         me 3
                                                             control
                                          N87-24491
                                                              [AAS PAPER 86-042]
                                                                                                  p 133 A87-32744
                                         (AOCS) tasks
                                                           SPACECRAFT INSTRUMENTS
                                         ng-undocking
                                                               Fiber-optic monitors for space structures
                                                                                                  p 11 A87-31505
                                          N87-24514
                                                               Design of an advanced two-phase capillary cold plate
                                         space station
                                                             [SAE PAPER 861829]
                                                               SAE PAPER 861829] p 41 A87-32663
Earth resources instrumentation for the Space Station
                                          N87-25339
                                                               olar Platform p 126 A87-44184
Preliminary system concepts for MODIS - A moderate
                                                             Polar Platform
                                         de control s
                                          N87-25395
                                                             resolution imaging spectrometer for EOS
                                                                                                 p 126 A87-44186
                                          N87-25582
                                                               Space Station tracking subsystem sensor evaluation p 85 A87-45520
                                          N87-25801
                                                               Operational instruments on the Space Station-Polar
                                         e RF sensor
                                                            Platforms - Contributions by NOAA and the international
                                                            community
                                                                                                 p 127 A87-53149
                                          N87-28588
                                                               The GDR and the Soviet space program - The optical
                                         h for orbital
                                                            instrument sector of the GDR contributions
                                          N87-29876
                                                                                                 p 155 A87-53559
                                                          SPACECRAFT LAUNCHING
                                              orbiter
                                                          Analysis of Intelsat V flight data
[AIAA PAPER 87-0784]
SPACECRAFT LUBRICATION
                                          N87-29877
                                          for Space
                                                                                                  p 16 A87-33679
                                          N87-29878
                                                               Space Station lubrication considerations
                                         ased system
                                                                                                p 104 N87-29879
                                                          SPACECRAFT MAINTENANCE
                                         stem control
                                                            Refueling satellites in space - The OSCRS program
[SAE PAPER 861797] p 88 A87-32645
                                          A87-32579
                                                                                                 p 88 A87-32645
                                                              A maintenance work station for Space Station
                                         etic aspects
                                                            [SAE PAPER 860933]
                                                                                                p 167 A87-38723
                                          A87-33002
                                                              Concepts for space maintenance of OTV engines p 136 A87-46000 P 100 A87-46704
                                          A87-33021
Human factors standards for space habitation
                                  p 162 A87-33022
                                                              Space station integrated wall design and penetration
Living in space: A handbook for space travellers
                                                            damage control
                                 p 162 A87-33475
                                                           [NASA-CR-179165]
```

p 39 N87-28581

## SPACECRAFT MANEUVERS

	me a second of manning for	Electrochemical processing of solid waste
SPACECRAFT MANEUVERS	The design and analysis of passive damping for aerospace systems	[NASA-CR-181128] p 137 N87-25443
Orbital modifications using forced tether-length	[AIAA PAPER 87-0891] p 58 A87-39644	Nuclear reactor power for a space-based radar. SP-100
variations p 124 A87-40858 Liquid propellant tank ullage bubble deformation and	Effect of crew motions on the spatial position of a	project
breakup in low gravity reorientation	spacecraft p 152 A87-41954	[NASA-TM-89295] p 79 N87-25838
[AIAA PAPER 87-2021] p 92 A87-45360	Adaptive momentum management for the dual keel	Space station electrical power system [NASA-TM-100140] p 80 N87-26144
Control of an autonomous spacecraft rendezvous and	Space Station	[NASA-TM-100140] p 80 N87-25144  An overview of photovoltaic applications in space
docking maneuver by means of image processing	[AIAA PAPER 87-2596] p 62 A87-50558	p 80 N87-26414
[DGLR PAPER 86-122] p 101 A87-48156	The dynamics and control of the Space Station polar	Advanced photovoltaic solar array design assessment
Combining space-based propulsive maneuvers and	platform [AIAA PAPER 87-2600] p 62 A87-50562	p 80 N87-26429
aerodynamic maneuvers to achieve optimal orbital	[AIAA PAPER 87-2600] p 62 A87-50562  Crew activity and motion effects on the space station	Space station power system p 80 N87-26447
transfer [AIAA PAPER 87-2567] p 93 A87-49617	p 165 N87-22744	Space station electrical power distribution analysis using
[AIAA PAPER 87-2567] p 93 A87-49617 Equations of motion for maneuvering flexible	Analytical determination of space station response to	a load flow approach p 80 N87-26699
	crew motion and design of suspension system for	Development of an alkaline fuel cell subsystem
spacecraft p 63 A87-52965 Variable structure control system maneuvering of	microgravity experiments p 67 N87-22752	[NASA-CR-172002] p 81 N87-28188
spacecraft p 64 N87-21989	Contact dynamics math model	Space station power semiconductor package [NASA-CR-180829] p 81 N87-28825
Dynamic finite element modeling of flexible structures	[NASA-CR-179147] p 71 N87-25801	[NASA-CR-180829] p 81 N87-28825 Proceedings of the Fifth European Symposium on
[AD-A177168] p 30 N87-22252	Analytical investigation of the dynamics of tethered	Photovoltaic Generators in Space
Suboptimal control of large flexible space structures	constellations in Earth orbit, phase 2 [NASA-CR-179149] p 130 N87-26083	[ESA-SP-267] p 81 N87-28959
experiencing rotational dynamics nonlinearities	[NASA-CR-179149] p 130 N87-26083 SPACECRAFT ORBITS	The space station power system p 81 N87-28960
[AD-A180606] p 71 N87-25352	Choice of the optimal angular position of a spacecraft	Alternative power generation concepts for space
Dynamics during thrust maneuvers of flexible spinning satellites with axial and radial booms p 71 N87-25355	in the constant-solar-orientation flight segment	p 81 N87-28961
Sampled nonlinear control for large angle maneuvers	p 148 A87-34207	AMOC: An alternative module configuration for
of flexible spacecraft p 71 N87-25358	A quantitative comparison of several orbital maneuvering	advanced solar arrays in low Earth orbits p 159 N87-28968
Automatic docking maneuver and attitude control s	vehicle configurations for satellite repair/replenishment	The high performance solar array GSR3
ystem p 71 N87-25395	[AD-A179106] p 161 N87-236//	p 81 N87-28972
SPACECRAFT MODELS	Computer modeling of high-voltage solar array	Improved solar generator technology for the EURECA
Prediction of random vibrational responses of a large	experiment using the NASCAP/LEO (NASA Charging	low Earth orbit p 159 N87-28974
spacecraft in acoustic environment by BLPF method	Analyzer Program/Low Earth Orbit) computer code	The INMARSAT solar array: The first Advanced Rigid
p 144 A87-32334	[AD-A182589] p 81 N87-28186 SPACECRAFT PERFORMANCE	Array (ARA) to fly p 82 N87-28975
A review of modelling techniques for the open and	Analysis of Intelsat V flight data	GaAs concentrator solar arrays p 82 N87-28977
closed-loop dynamics of large space systems p 12 A87-32337	[AIAA PAPER 87-0784] p 16 A87-33679	The Fokker Strongback solar array p 82 N87-28979
Influence co-efficient testing as a substitute for modal	Performance of an SP-100/pulsed electrothermal	MARECS and ECS anomalies: Attempt at insulation defect production in Kapton p 82 N87-28980
survey testing of large space structures	thruster orbit transfer vehicle	Micrometeorite impact on solar panels ESA
p 27 N87-20369	[AIAA PAPER 87-2027] p 77 A87-45363	telecommunication satellites p 82 N87-28981
Wave propagation in transversely isotropic continuum	SPOT solar array in-orbit deployment results evaluation p 83 N87-28986	Aerospatiale solar arrays, in orbit performance
models of LSS (Large Space Structures)	evaluation p 83 N87-28966 SPACECRAFT POWER SUPPLIES	p 159 N87-28988
[AD-A177271] p 30 NB7-22256 Considerations in the design and development of a	Laboratory simulation of plasma interaction with high	Organic Rankine cycle power conversion systems for
space station scale model p 9 N87-22711	voltage solar array p 145 A87-32388	space applications p 159 N87-28989
Maximum likelihood parameter identification of flexible	ERATO orbital transfer vehicle with electronuclear power	Thermal-electrical dynamical simulation of spacecraft solar array p 83 N87-29004
spacecraft	Study of the associated electronuclear generator	solar array p 83 N87-29004 The extendable and retractable mast as supporting tool
[FTN-87-90235] p 38 N87-27705	p 75 A87-36944	for rigid solar arrays p 39 N87-29012
Study on investigation of the attitude control of large	Manned spacecraft electrical power systems p 75 A87-37291	The liquid droplet radiator in space: A parametric
flexible spacecraft. Phase 2, volume 1: Executive summary		approach
laboratory test model	Tether power supplies exploiting the characteristics of	[AD-A182605] p 46 N87-29217
[ESA-CR(P)-2361-VOL-1] p 73 N87-27707	space [AAS PAPER 86-227] p 123 A87-38571	Application of advanced flywheel technology for energy
Study on the investigation of the attitude control of large flexible spacecraft. Phase 2, volume 2: Technical report	Plasma motor/generator reference system designs for	storage on space station p 74 N87-29933
laboratory test model	power and propulsion	SPACECRAFT PROPULSION
[ESA_CR(P)-2361-VOI-2] p 73 N87-27708	[AAS PAPER 86-229] p 89 A87-38572	Mechanical design of the Eurostar platform p 149 A87-34874
Study on investigation of the attitude control of large	Resistojet control and power for high frequency ac	Plasma motor/generator reference system designs for
flexible spacecraft, phase 3	buses	power and propulsion
[ESA-CR(P)-2361-VOL-4] p 73 N87-27709	[AIAA PAPER 87-0994] p 58 A87-41103	[AAS PAPER 86-229] p 89 A87-38572
SPACECRAFT MODULES	The radiation impedance of an electrodynamic tether with end connectors p 125 A87-42585	Development of the electrical power subsystem for the
Thermal verification method for large sized spacecraft	with end connectors p 125 A87-42585  The benefit of phase change thermal storage for	electric propulsion experiment onboard the Space Flyer
p 144 A87-32368	spacecraft thermal management	Unit (SFU)
Development of carbon dioxide removal system -	[AIAA PAPER 87-1482] p 43 A87-43014	[AIAA PAPER 87-1040] p 76 A87-39628
Experimental study of solid amines p 145 A87-32456	Liquid droplet radiator development status waste heat	Development of control and monitor subsystem for electric propulsion experiment onboard Space Flyer Unit
Status of Japanese Experiment Module design p 145 A87-32531	rejection devices for future space vehicles	(SFU)
	[AIAA PAPER 87-1537] p 43 A87-43059	[AIAA PAPER 87-1041] p 76 A87-39629
Development of exposed deck of Japanese experiment p 145 A87-32532	New power processor interfaces MMS power module	Electrodynamic tether propulsion - Potential uses and
Japanese experiment module data management and	outputs Multimission Modular Spacecraft p 77 A87-48264	open issues p 124 A87-40510
communication system p 147 A87-32542	Use of lightweight composites for GAS payload	1987 status report - United States Air Force electric
Habitation module for the Space Station	structures p 25 N87-20307	propulsion research and development
[SAE PAPER 860928] p 163 A87-38718	Liquid droplet radiator development status	[AIAA PAPER 87-1036] p 90 A87-41122
Status of the Space Station environmental control and	[NASA-TM-89852] p 44 N87-20353	Concepts for space maintenance of OTV engines
life support system design concept	Resistojet control and power for high frequency ac	Thermal design of a large spacecraft propulsion
[SAE PAPER 860943] p 48 A87-38730	buses	
Special considerations in outfitting a space station	[NASA-TM-89860] p 63 N87-20477	system [AIAA PAPER 87-1863] p 44 A87-45258
module for scientific use	Structural concepts for large solar concentrators	Performance of an SP-100/pulsed electrothermal
[SAE PAPER 860956] p 164 A87-38741	[NASA-CR-4075] p 65 N87-21994 Coaxial tube array space transmission line	thruster orbit transfer vehicle
Habitability issues for the Science Laboratory Module	Coaxial tube array space transmission line characterization	[AIAA PAPER 87-2027] p 77 A87-45363
[SAE PAPER 860971] p 50 A87-38753	[NASA-TM-89864] p 96 N87-22003	Ion thrusters advance p 93 A87-54196
Japanese Experiment Module (JEM) preliminary design	EMC and power quality standards for 20-kHz power	Developing Space Station. II - Power, rendezvous,
status p 151 A87-41570	distribution	docking and remote sensing are important elements of
Composite fiber/metal Space Station tankage	[NASA-TM-89925] p 78 N87-22004	the Space Station p 127 A87-54198
Applications, material/process/design trades, and	Selection of high temperature thermal energy storage	Propellant tank resupply system [AD-D012559] p 93 N87-20375
subscale manufacturing/test results	materials for advanced solar dynamic space power	Orbital transfer vehicle concept definition and system
[MMM   M Elifer = 101]	systems (NASA-TM-89886) p 78 N87-22174	analysis study. Volume 1A: Executive summary. Phase 2
	[NASA-TM-89886] p /8 N8/-221/4 Control considerations for high frequency, resonant,	[NASA-CR-179055] p 161 N87-21018
New power processor interfaces MMS power module	power processing equipment used in large systems	System technology analysis of aeroassisted orbital
outputs Multimission Modular Spacecraft p 77 A87-48264	[NASA-TM-89926] p 68 N87-23690	transfer vehicles. Moderate lift/drag (0.75-1.5): Volume 1A,
Space station group activities habitability module study	Assessment of space station power system	part 2: Executive summary, phase 2
[NASA-CR-4010] p 165 N87-21585	[ATES-AN-86/466] p 79 N87-24530	[NASA-CR-179140] p 3 N87-26063
SPACECRAFT MOTION	Status of series-resonant power conversion with high	System technology analysis of aeroassisted orbital
Some approximations for the dynamics of spacecraft	internal frequencies. Support in definition of space station	transfer vehicles: Moderate lift/drag (0.75-1.5), Volume 1B,

power interface [ESA-CR(P)-2319]

part 2, study results [NASA-CR-179142]

p 79 N87-24533

p 4 N87-26067

tethers [AIAA PAPER 87-0821]

Some approximations for the dynamics of spacecraft

p 122 A87-33687

Propulsion recommendations for space station free	Adaptive planar truss structures and their vibration	The capabilities of Eureca thermal control for future
flying platforms p 98 N87-26129	characteristics	mission scenarios
Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135	[AIAA PAPER 87-0743] p 148 A87-33667 Effects of local vibrations on the dynamics of space	[SAE PAPER 860936] p 42 A87-38725 Infrared test technique validation on the Olympus
SPACECRAFT RADIATORS	truss structures	satellite
Enhancement of solar absorptance degradation due to	[AIAA PAPER 87-0941] p 17 A87-33739 Comparison of the Craig-Bampton and residual flexibility	[SAE PAPER 860939] p 150 A87-38728
contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory	methods of substructure representation	Quality monitoring in two-phase heat transport systems for large spacecraft
measurements p 144 A87-32346	p 19 A87-34510	[SAE PAPER 860959] p 42 A87-38743
A thermally-pumped heat transport system	International SAMPE Technical Conference, 18th, Seattle, WA, Oct. 7-9, 1986, Proceedings	Evaluation of Space Station thermal control
p 40 A87-32369	p 167 A87-38576	techniques [SAE PAPER 860998] p 42 A87-38775
Environmental avoidance concepts for steerable Space Station radiators	Joint technology for graphite epoxy space structures	Thermal test results of the two-phase thermal bus
[SAE PAPER 861831] p 41 A87-32665	p 20 A87-38600 Martin Marietta atomic oxygen beam facility	technology demonstration loop
High capacity demonstration of honeycomb panel heat	p 139 A87-38622	[AIAA PAPER 87-1627] p 44 A87-43125
pipes [SAE PAPER 861833] p 41 A87-32666	A high flux pulsed source of energetic atomic oxygen	Radiation heat transfer calculations for space structures
Space station active thermal control system modelling	for spacecraft materials ground testing p 139 A87-38623	[AIAA PAPER 87-1522] p 44 A87-44830
[AIAA PAPER 87-1468] p 43 A87-43003	Production of pulsed atomic oxygen beams via laser	Thermal design of a large spacecraft propulsion
Liquid sheet radiator [AIAA PAPER 87-1525] p 43 A87-43048	vaporization methods p 106 A87-38625 Structure-property relationships in polymer resistance	system [AlAA PAPER 87-1863] p 44 A87-45258
Liquid droplet radiator development status waste heat	to atomic oxygen p 106 A87-38642	Development of an emulation-simulation thermal control
rejection devices for future space vehicles	Application of reanalysis techniques in dynamic analysis	model for space station application
[AIAA PAPER 87-1537] p 43 A87-43059	of spacecraft structures p 21 A87-38824 Dynamics of a multibody system with relative translation	[NASA-CR-181009] p 45 N87-26072
Liquid droplet radiator development status [NASA-TM-89852] p 44 N87-20353	on curved, flexible tracks p 58 A87-40867	Spacecraft ram glow and surface temperature p 10 N87-26205
The liquid droplet radiator in space: A parametric	Expected size of a crater resulting from the impact of	SPACECRAFT TRACKING
approach [AD-A182605] p 46 N87-29217	a micrometeorite p 119 A87-41870 Actuators for actively controlled space structures	Space Station communications and tracking system
[AD-A182605] p 46 N87-29217 SPACECRAFT RECOVERY	p 59 A87-42816	p 134 A87-37297
The mission function control for deployment and retrieval	Radiation heat transfer calculations for space	Space Station tracking subsystem sensor evaluation p 85 A87-45520
of subsatellite [AIAA PAPER 87-2326] p 126 A87-50447	structures [AIAA PAPER 87-1522] p 44 A87-44830	Research in slewing and tracking control
SPACECRAFT REENTRY	Low-authority control of large space structures by using	p 70 N87-24512
Nonequilibrium radiation during re-entry at 10 km/s	tendon control system	Track and capture of the orbiter with the space station remote manipulator system
[AIAA PAPER 87-1543] p 135 A87-43060 SPACECRAFT RELIABILITY	[AIAA PAPER 87-2249] p 60 A87-50413 Structure and design of spacecraft Russian book	[NASA-TM-89221] p 137 N87-25339
Recent developments and future trends in structural	p 155 A87-51870	Integration of communications and tracking data
dynamic design verification and qualification of large	Mechanical Qualification of Large Flexible Spacecraft	processing simulation for space station
flexible spacecraft p 156 N87-20357  SPACECRAFT SHIELDING	Structures [AD-A175529] p 26 N87-20355	p 115 N87-25890 SPACECRAFT TRAJECTORIES
Radiation shielding requirements on long-duration space	Future trends in spacecraft design and qualification	Track and capture of the orbiter with the space station
missions	p 2 N87-20356	remote manipulator system
[AD-A177512] p 140 N87-21991 SPACECRAFT STABILITY	Dynamic analysis of direct television satellite TV-SAT/TDF.1 p 86 N87-20360	[NASA-TM-89221] p 137 N87-25339 Suboptimal control of large flexible space structures
A consideration to vibration control for a large space	Structural qualification of large spacecraft	experiencing rotational dynamics nonlinearities
structures p 54 A87-32441	p 26 N87-20361 Effect of modal damping in modal synthesis of spacecraft	[AD-A180606] p 71 N87-25352
Flexibility control of torsional vibrations of a large solar array p 12 A87-32442	structures p 26 N87-20362	SPACECREWS Living in space: A handbook for space travellers
Vibration control for a linked system of flexible	Dynamic qualification of spacecraft by means of modal	p 162 A87-33475
structures p 55 A87-32444 The Softmounted Inertially Reacting Pointing System	synthesis p 26 N87-20363 Low frequency vibration testing on satellites	Effect of crew motions on the spatial position of a spacecraft p 152 A87-41954
(SIRPNT)	p 27 N87-20364	spacecraft p 152 A87-41954 Evaluation of physical work capacity of cosmonauts
[AAS PAPER 86-007] p 56 A87-32732	Modal-survey testing for system identification and	aboard Salyut-6 station p 157 N87-20735
Stability in the relative equilibrium positions of space stations at triangular libration points in the	dynamic qualification of spacecraft structures p 27 N87-20365	Crew activity and motion effects on the space station p 165 N87-22744
photogravitational three-body problem p 1 A87-32802	Active structural controllers emulating structural	Analytical determination of space station response to
Vibration suppression using a constrained rate-feedback	elements by ICUs p 27 N87-20367 Spacecraft qualification using advanced vibration and	crew motion and design of suspension system for
Threshold control strategy for large space structures [AIAA PAPER 87-0741] p 6 A87-33665	modal testing techniques p 27 N87-20368	microgravity experiments p 67 N87-22752 A quantitative comparison of several orbital maneuvering
Modal analyses of dynamics of a deformable multibody	Influence co-efficient testing as a substitute for modal	vehicle configurations for satellite repair/replenishment
spacecraft - The Space Station: A continuum approach [AIAA PAPER 87-0925] p 17 A87-33727	survey testing of large space structures p 27 N87-20369	[AD-A179106] p 161 N87-23677
Tethered satellite program control strategy	Acoustic effects on the dynamic of lightweight	SPACELAB The industrial use of Spacelab p 168 A87-40286
[AAS PAPER 86-221] p 123 A87-38570	structures p 28 N87-20372	Evolution of data management systems from Spacelab
Variable structure controller design for spacecraft nutation damping p 58 A87-39958	Multi-axis vibration tests on spacecraft using hydraulic exciters p 8 N87-20373	to Columbus [AIAA PAPER 87-2227] p 154 A87-48605
Active vibration control synthesis for the COFS-I - A	Optimization of aerospace structures subjected to	SPACELAB PAYLOADS
classical approach Control of Flexible Structures experiment for NASA	random vibration and fatigue constraints p 29 N87-20599	Infra-red astronomy after IRAS p 127 A87-54197
[AIAA PAPER 87-2322] p 23 A87-50443	Stress and deformation analysis of lightweight	SPACERS  Model study of simplex masts for space
The coupled dynamics of fluids and spacecraft in low	composite structures space antennas	applications p 144 A87-32339
gravity and low gravity fluid measurement p 94 N87-21147	[MBB-UD-489/86] p 30 N87-22269	SPACETENNAS
A formulation for studying steady state/transient	Investigation for damping design and related nonlinear vibrations of spacecraft structures	Static shape control for flexible structures [SAE PAPER 861822] p 13 A87-32658
dynamics of a large class of spacecraft and its	[EMSB-64/85] p 35 N87-24516	Integrated structural electromagnetic optimization of
application p 35 N87-25357 SPACECRAFT STRUCTURES	Suboptimal control of large flexible space structures	large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611
Transient dynamics of orbiting flexible structural	experiencing rotational dynamics nonlinearities [AD-A180606] p 71 N87-25352	[AIAA PAPER 87-0824] p 14 A87-33611 Quasi-static shape adjustment of a 15 meter diameter
members p 54 A87-32338	Development of experimental/analytical concepts for	space antenna
Structure and function of Deployable Truss Beam (DTB) p 12 A87-32548	structural design verification spacecraft structures	[AIAA PAPER 87-0869] p 15 A87-33633 Robust control of a large space antenna
Critical length for stable elongated orbiting structures	[ESA-CR(P)-2340] p 36 N87-26075 Substructure analysis using NICE/SPAR and	[AIAA PAPER 87-2253] p 86 A87-50417
p 148 A87-32819 ASTROS - A multidisciplinary automated structural	Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures	SPACING
design tool	spacecraft masts	A method of variable spacing for controlled plant growth systems in spaceflight and terrestrial agriculture
[AIAA PAPER 87-0713] p 6 A87-33557	[NASA-CR-180317] p 38 N87-27260	applications

SPACECRAFT TEMPERATURE

[SAE PAPER 861828]

Thermal verification method for large sized spacecraft

Development status of a two-phase thermal management system for large spacecraft

Development of fluid loop system for spacecraft

p 144 A87-32368

p 144 A87-32370

p 41 A87-32662

An equivalent continuum analysis procedure for Space

[AIAA PAPER 87-0724] p 13 A87-33564 Structures, Structural Dynamics and Materials Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA Dynamics Specialists Conference, Monterey, CA, Apr. 9, 10, 1987, Technical Papers. Parts 2A & 2B

p 15 A87-33654

Station lattice structures

p 130 N87-25767

Design study of large area 8 cm x 8 cm wrapthrough ells for space station p 80 N87-26424

Spectral factorization and homogenization methods for modeling and control of flexible structures [AD-A179726] p 35 N87-24517

[NASA-CR-177447]

cells for space station

SPECTRAL METHODS

**SPECIFICATIONS** 

structures

A consideration to vibration control for a large space tructures p 54 A87-32441

Structural design and component tests of large geostationary satellite bus p 144 A87-32335

	Improving stability margins in discrete-time LQG	Design consideration of mechanical and deployment
SPECTRAL SENSITIVITY	controllers p 31 N87-22719	properties of a coilable lattice mast p 12 A87-32340
Absolute indoor calibration of large area solar cells		Integrated control/structure design and robustness
p 159 N87-29015	STORAGE BATTERIES Use of lightweight composites for GAS payload	[SAE PAPER 861821] p 6 A87-32657
SPEECH RECOGNITION		ASTROS - A multidisciplinary automated structural
Use of heads-up displays, speech recognition, and		design tool
speech synthesis in controlling a remotely piloted space vehicle p 99 A87-31493	STORAGE STABILITY	[AIAA PAPER 87-0713] p 6 A87-33557
vehicle p 99 A87-31493	The coupled dynamics of fluids and spacecraft in low	Control augmented structural synthesis with transient
Developing a voice-controlled, computer-generated	gravity and low gravity fluid measurement p 94 N87-21147	response constraints
display to assist space station astronauts during	•	[AIAA PAPER 87-0749] p 56 A87-33573
maintenance activity (AD-A178997) p 120 N87-22762	STORAGE TANKS	Simultaneous structure/control optimization of large
[//5////000//]	Composite fiber/metal Space Station tankage -	flexible spacecraft
SPIN DYNAMICS  Dynamic analysis of the flexible boom in the N-ROSS	Applications, material/process/design trades, and	[AIAA PAPER 87-0823] p 14 A87-33610
	subscale manufacturing/test results [AIAA PAPER 87-2157] p 160 A87-45441	Design considerations for a one-kilometer antenna
satellite [AD-A181488] p 72 N87-26966		stick
[AD-A181488] p /2 N87-20900 SPIN STABILIZATION	Advanced long term cryogenic storage systems p 94 N87-21142	[AIAA PAPER 87-0871] p 15 A87-33635
Dynamics during thrust maneuvers of flexible spinning		Identification of the zero-g shape of a space beam
satellites with axial and radial booms p 71 N87-25355	Shuttle middeck fluid transfer experiment: Lessons	[AIAA PAPER 87-0872] p 15 A87-33636
SPOT (FRENCH SATELLITE)	learned p 95 N87-21158	Structural and control optimization of space structures
Attitude control of a spacecraft using an extended	STRAIN ENERGY METHODS	[AIAA PAPER 87-0939] p 17 A87-33737
self-organizing fuzzy logic controller p 59 A87-41617	Design consideration of mechanical and deployment	Mechanical design of the Eurostar platform p 149 A87-34874
Remote sensing applications: Commercial issues and	properties of a collable lattice mast p 12 A87-32340	
opportunities for space station SPOT	STRAIN MEASUREMENT	Structure and design of spacecraft Russian book p 155 A87-51870
p 156 N87-20626	Fiber-optic monitors for space structures	p 155 Me7-51670
SPOT/MEGS design and flight results obtained solar	p 11 A87-31505	Space station electric power system requirements and
array drive (MEGS) p 103 N87-29009	STRATEGY	design [NASA-TM-89889] p 96 N87-22001
SPRINGS (ELASTIC)	Space Station end effector strategy study	
New time-domain identification technique for vibrating	[NASA-TM-100488] p 103 N87-29593	Integrated control/structure design and robustness p 65 N87-22060
structures p 58 A87-40869	STRESS ANALYSIS	
STABILITY AUGMENTATION	Analytical solutions for static elastic deformations of wire	Investigation for damping design and related nonlinear
Gravity-gradient stabilization of the Salyut 6-Soyuz	ropes	vibrations of spacecraft structures [FMSB-64/85] p 35 N87-24516
orbital complex p 147 A87-32801	[AIAA PAPER 87-0720] p 6 A87-33561	[EMSB-64/85] p 35 N8/-24516
STANDARDS	Structural and preliminary thermal performance testing	The Fokker Strongback solar array p 82 N87-28979
Human factors standards for space habitation	of a pressure activated contact heat exchanger	STRUCTURAL DESIGN CRITERIA
p 162 A87-33022	[AIAA PAPER 87-1540] p 44 A87-44843	Structural optimization with frequency constraints
The Consultative Committee for Space Data Systems	Stress and deformation analysis of lightweight	[AIAA PAPER 87-0787] p 13 A87-33588
	composite structures space antennas	Comparison of satellite support structure aluminum
Standards program (AIAA PAPER 87-2204) p 113 A87-48589	[MBB-UD-489/86] p 30 N87-22269	versus graphite epoxy
[MINITIAL ELICOT === 1]	STRINGERS	[SAWE PAPER 1692] p 20 A87-36279
STATE ESTIMATION	Preloaded space structural coupling joints	Gradient-based combined structural and control
Single-mode projection filters for identification and state	[NASA-CASE-LAR-13489-1] p 38 N87-27713	optimization p 21 A87-40866
estimation of flexible structures [AIAA PAPER 87-2387] p 24 A87-50471	STRUCTURAL ANALYSIS	A basis change strategy for the reduced gradient method
[AIAA PAPER 87-2387] p 24 A87-50471 Square root state estimator for large space structures	Validation of large space structures by ground tests	and the optimum design of large structures
[AIAA PAPER 87-2389] p 24 A87-50473	p 11 A87-32336	p 23 A87-48341
[AIAA PAPER 87-2389] p 24 A87-50473 A spline-based parameter and state estimation	Development of exposed deck of Japanese experiment	Advanced EVA system design requirements study:
A spline-based parameter and state community	module p 145 A87-32532	EVAS/space station system interface requirements
technique for static models of elastic surfaces [NASA-CR-180449] p 11 N87-30107	Structures, Structural Dynamics and Materials	[NASA-CR-171981] p 120 N87-20351
[Intervention ]	Conference, 28th, Monterey, CA, Apr. 6-8, 1987, Technical	The results of a limited study of approaches to the
STATIC DEFORMATION	Papers. Part 1 p 13 A87-33551	design, fabrication, and testing of a dynamic model of the
Analytical solutions for static elastic deformations of wire	Reduced modeling and analysis of large repetitive space	NASA IOC space station. Executive summary
ropes [AIAA PAPER 87-0720] p 6 A87-33561	structures via continuum/discrete concepts	[NASA-CR-178276] p 8 N87-21020
	p 19 A87-35327	Space station structures and dynamics test program
Optimum shape control of flexible beams by	U.S. National Congress of Applied Mechanics, 10th,	p 33 N87-22751
piezo-electric actuators	University of Texas, Austin, June 16-20, 1986,	Development of experimental/analytical concepts for
[NASA-CR-181413] p 40 N87-29898	Descendings	structural design verification spacecraft structures
STATIC DISCHARGERS	Proceedings (AD-A181962) p.1 A87-40051	[ESA-CR(P)-2340] p 36 N87-26075
Electrostatic immunity of geostationary satellites p 143 N87-26957	[AD-A181962] p.1 A87-40051 Dynamic modeling and optimal control design for large	Design of a mixed fleet transportation system to low
· · · · · · · · · · · · · · · · · · ·	flexible space structures p 26 N87-20358	Earth orbit. Volume 1: Executive summary. Volume 2:
STATIC LOADS	OPUS: Optimal Projection for Uncertain Systems	Near-term shuttle replacement. Volume 3: Heavy-lift cargo
Influence co-efficient testing as a substitute for modal	[AD-A176820] p 29 N87-21025	vehicle. Volume 4: Advanced technology shuttle
survey testing of large space structures p 27 N87-20369	Modeling and control of flexible structures	replacement p 5 N87-29583
· · · · · · · · · · · · · · · · · · ·	[AD-A177106] p 29 N87-21388	STRUCTURAL ENGINEERING
STATIC MODELS  A spline-based parameter and state estimation	Structural concepts for large solar concentrators	Deployable surface truss concepts and two-dimensional
A spline-based parameter and state community	[NASA-CR-4075] p 65 N87-21994	adaptive structures p 144 A87-32341
technique for static models of elastic surfaces [NASA-CR-180449] p 11 N87-30107	Dynamic finite element modeling of flexible structures	Structures, Structural Dynamics and Materials
[NASA-CR-180449] p 11 N87-30107 STEADY STATE	[AD-A177168] p 30 N87-22252	Conference, 28th, Monterey, CA, Apr. 6-8, 1987 and AIAA
A formulation for studying steady state/transient	Status of the Mast experiment p 30 N87-22703	Dynamics Specialists Conference, Monterey, CA, Apr. 9,
dynamics of a large class of spacecraft and its	Identification of large space structures: A	10, 1987, Technical Papers. Parts 2A & 2B
application p 35 N87-25357	state-of-practice report p 31 N87-22705	p 15 A87-33654
application	Impact of space station appendage vibrations on the	STRUCTURAL FAILURE
STEERING  A highly adaptable steering/selection procedure for	pointing performance of gimballed payloads	Automatic generation of stochastically dominant failure
combined CMG/RCS spacecraft control	p 32 N87-22733	modes for large-scale structures p 149 A87-37853
[AAS PAPER 86-036] p 56 A87-32741	A TREETOPS simulation of the Hubble Space	STRUCTURAL STABILITY
STELLAR MOTIONS	Telescope-High Gain Antenna interaction	Transient dynamics of orbiting flexible structural
Astronomic Telescope Facility: Preliminary systems	p 9 N87-22735	members p 54 A87-32338
definition study report. Volume 2: Technical description	Design, development and fabrication of a	Modeling, stabilization and control of serially connected
	deployable/retractable truss beam model for large space	beams p 21 A87-41052
[NASA-TM-89429-VOL-2] p 129 N87-22570 Astrometric Telescope Facility preliminary systems	structures application	Dynamic and thermal effects in very large space
definition study. Volume 1: Executive summary	[NASA-CR-178287] p 35 N87-25349	structures p 25 N87-20347
[NASA-TM-89429-VOL-1] p 129 N87-22571	Shape design sensitivity analysis and optimal design of	Structural control by the use of piezoelectric active
STIFFNESS	structural systems	members p 69 N87-24509
Dynamic characteristics of a vibrating beam with periodic	[NASA-CR-181095] p 37 N87-26370	Ground test of large flexible structures
	Dynamic analysis of the flexible boom in the N-ROSS	p 34 N87-24510
	satellite	
STIFFNESS MATRIX Flexibility effects - Estimation of the stiffness matrix in	[AD-A181488] p 72 N87-26966	
the dynamics of a large structure p 23 A87-48714	Substructure analysis using NICE/SPAR and	applications of force to linear and nonlinear structures
the dynamics of a large structure p 23 A87-48714	applications of force to linear and nonlinear structures	spacecraft masts [NASA-CR-180317] p 38 N87-27260
A general method for dynamic analysis of structures	spacecraft masts	[renewation of the control of the co
010(1)011	[NASA-CR-180317] p 38 N87-27260	STRUCTURAL VIBRATION
STIRLING CYCLE	Computational procedures for evaluating the sensitivity	Space structure vibration modes - How many exist?
Permanent-magnet linear alternators. I - Fundamental equations. II - Design guidelines p 76 A87-39735		
	derivatives of vibration frequencies and Finanmodes of	Which ones are important? p 11 A87-32120
	derivatives of vibration frequencies and Eigenmodes of	Prediction of random vibrational responses of a large
Survey of solar-dynamic space power - The Stirling	derivatives of vibration frequencies and Eigenmodes of framed structures	Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method
	derivatives of vibration frequencies and Eigenmodes of	

STOCHASTIC PROCESSES

modes for large-scale structures

Automatic generation of stochastically dominant failure nodes for large-scale structures p 149 A87-37853

[AIAA PAPER 87-0869]

p 15 A87-33633

Adaptive planar truss structures and their vibration Analysis of on-orbit thermal characteristics of the SYSTEM IDENTIFICATION 15-meter hoop/column antenna [NASA-TM-89137] MOVER II - A computer program for verifying [AIAA PAPER 87-0743] p 148 A87-33667 duced-order models of large dynamic systems n 45 N87-21021 Spillover stabilization and decentralized modal control SURFACE GEOMETRY [SAE PAPER 861790] p 5 A87-32639 of large space structures Quasi-static shape adjustment of a 15 meter diameter System identification of a truss type space structure [AIAA PAPER 87-0903] p 17 A87-33712 space antenna using the multiple boundary condition test (MBCT) AIAA PAPER 87-0869] Accuracy of derivatives of control performance using a p 15 A87-33633 SURFACE REACTIONS reduced structural model [AIAA PAPER 87-0746] p 16 A87-33670 [AIAA PAPER 87-0905] p 57 A87-33714 Martin Marietta atomic oxygen beam facility Incorporation of the effects of material damping and p 139 A87-38622 Localization of vibrations in large space reflectors nonlinearities on the dynamics of space structures Production of pulsed atomic oxygen beams via laser [AIAA PAPER 87-0949] p 18 A87-33745 p 21 A87-40075 p 106 A87-38625 vaporization methods Optimal vibration control by the use of piezoceramic Identification of large space structures - A factorization Proceedings of the NASA Workshop on Atomic Oxygen nsors and actuators p 25 A87-52966 Effects --- low earth orbital environment [NASA-CR-181163] [AIAA PAPER 87-0959] Modal-survey testing for system identification and p 18 A87-33751 p 141 N87-26173 Control of flexible structures by applied thermal dynamic qualification of spacecraft structures Review of Low Earth Orbital (LEO) flight experiments p 27 N87-20365 gradients p 21 A87-39543 p 131 N87-26174 New time-domain identification technique --- for vibrating Identification of large space structures: Material interactions with the Low Earth Orbital (LEO) state-of-practice report p 31 N87-22705 structures D 58 A87-40869 environment: Accurate reaction rate measurements SYSTEMS ANALYSIS Active vibration control of a simply supported beam using p 108 N87-26175 System and operation analyses of OTV Network - A a spatially distributed actuator Mass spectrometers and atomic oxygen p 23 A87-50232 new space transportation concept p 145 A87-32475 Low-authority control of large space structures by using D 141 N87-26176 Large space antennas: A systems analysis case Interaction of hyperthermal atoms on surfaces in orbit: tendon control system [AIAA PAPER 87-2249] The University of Alabama experiment p 60 A87-50413 [NASA-TM-89072] p 26 N87-20352 Control of distributed structures p 108 N87-26177 Space station structures and dynamics test program (ASA-TP-2710) p 28 N87-20568 with small nonproportional damping O-atom degradation mechanisms of materials [NASA-TP-2710] p 141 N87-26178 [AIAA PAPER 87-2250] p 60 A87-50414 An astrometric facility for planetary detection on the Product energy distributions and energy partitioning in The control of linear dampers for large space p 108 N87-26180 O atom reactions on surfaces structures [NASA-TM-89436] p 128 N87-20841 [AIAA PAPER 87-2251] The role of electronic mechanisms in surface erosion p 60 A87-50415 Orbital transfer vehicle concept definition and system and glow phenomena p 137 N87-26181 nalysis study. Volume 1A: Executive summary. Phase 2 Tracking and pointing maneuvers with slew-excited Potential energy surfaces for atomic oxygen reactions: deformation shaping [NASA-CR-179055] p 161 N87-21018 Formation of singlet and triplet biradicals as primary reaction products with unsaturated organic molecules [AIAA PAPER 87-2599] p 62 A87-50561 A quasi-analytical method for non-iterative computation Identification of large space structures - A factorization of nonlinear controls n 66 N87-22731 p 108 N87-26182 A systems analysis of emergency escape and recovery approach p 25 A87-52966 Dynamics of atom-surface interactions systems for the US space station Dynamic analysis of direct television satellite p 141 N87-26183 [AD-A1792331 TV-SAT/TDF 1 p 86 N87-20360 p.3 N87-23680 Laboratory studies of atomic oxygen reactions with System technology analysis of aeroassisted orbital Dynamic qualification of spacecraft by means of modal p 4 N87-26185 solids transfer vehicles. Moderate lift/drag (0.75-1.5). Volume 1A, p 26 N87-20363 synthesis Pulsed source of energetic atomic oxygen part 1: Executive summary, phase 1 Low frequency vibration testing on satellites p 108 N87-26189 [NASA-CR-179139] p 97 N87-26062 p 27 N87-20364 System technology analysis of aeroassisted orbital transfer vehicles. Moderate lift/drag (0.75-1.5): Volume 1A, Reactions of atomic oxygen (O(P-3)) with polybutadienes Benefits of passive damping as applied to active control and related polymers p 109 N87-26197 p 63 N87-20371 of large space structures part 2: Executive summary, phase 2 Chemical interactions in Low Earth Orbit (LEO) Multi-axis vibration tests on spacecraft using hydraulic [NASA-CR-1791401 p 3 N87-26063 p 109 N87-26198 p8 N87-20373 exciters System technology analysis of aeroassisted orbital Groundbased studies of spacecraft glow and erosion Some problems in the control of large space transfer vehicles: Moderate lift/drag (0.75-1.5). Volume 3: caused by impact of oxygen and nitrogen beams structures Cost estimates and work breakdown structure/dictionary, [AD-A179989] p 109 N87-26200 p 70 N87-25350 Vibrations and structureborne noise in space station NASA-CR-181381] p 39 N87-29590 Potential surfaces for O atom-polymer reactions phase 1 and 2 [NASA-CR-179144] [NASA-CR-181381] p 109 N87-26201 p 3 N87-26064 System technology analysis of aeroassisted orbital transfer vehicles: Moderate lift/drag (0.75-1.5). Volume 2: NASA Marshall Space Flight Center atomic oxygen STRIITS Design, construction, and utilization of a space station p 109 N87-26202 investigations Supporting research and technology report, phase 1 and assembled from 5-meter erectable struts Spacecraft ram glow and surface temperature p 34 N87-24501 p 10 N87-26205 [NASA-CR-179143] p 3 N87-26065 SUBSTRUCTURES Comments on the interaction of materials with atomic System technology analysis of aeroassisted orbital Practical implementation of an accurate method for p 110 N87-26206 multilevel design sensitivity analysis transfer vehicles: Moderate lift/drag (0.75-1.5), Volume 1B, Effect of long-term exposure to Low Earth Orbit (LEO) part 2, study results [AIAA PAPER 87-0718] p 6 A87-33560 NASA-CR-179142] space environment p 142 N87-26207 p 4 N87-26067 Comparison of the Craig-Bampton and residual flexibility SURFACE TEMPERATURE Fiber optic data systems p 117 N87-29152 methods of substructure representation Advanced local area network concepts Spacecraft ram glow and surface temperature p 19 A87-34510 NICE/SPAR and p 117 N87-29153 p 10 N87-26205 Substructure analysis using Phase 3 study of selected tether applications in space. **SWATH WIDTH** applications of force to linear and nonlinear structures ---Volume 1: Executive summary Summary of recent SAR instrument studies acecraft masts [NASA-CR-179185] p 131 N87-29585 p 159 N87-27865 [NASA-CR-180317] SUPERCRITICAL FLUIDS p 38 N87-27260 SYSTEMS ENGINEERING **SWITCHING CIRCUITS** Water recycling for Space Station p 46 A87-32459 Power management equipment for space applications [SAE PAPER 861621] p 74 A87-32578 Supercritical water oxidation - Concept analysis for Development of a small-sized space manipulator evolutionary Space Station application [SAE PAPER 860993] p 74 A87-32578 p 101 A87-51979 An advanced wind scatterometer for the Columbus Polar Space station power semiconductor package p 51 A87-38770 [NASA-CR-180829] p 81 N87-28825 Platform payload p 155 A87-53117 Transferring superfluid helium in space SYNCHRONOUS PLATFORMS Dynamic analysis of direct television satellite Geostationary platforms - An international perspective p 88 A87-34712 TV-SAT/TDF.1 p 86 N87-20360 Superfluid helium on orbit transfer (SHOOT) p 121 A87-32288 A quantitative comparison of several orbital maneuvering p 95 N87-21151 Communication missions for geostationary platforms vehicle configurations for satellite repair/replenishment SUPERHIGH FREQUENCIES p 84 A87-34797 [AD-A179106] p 161 N87-23677 On-board K- and S-band multi-beam antennas Working group on Earth observation requirements for Assessment of space station power system the Polar Orbiting Platform Elements of the International Space Station (the POPE Working Group) p 86 A87-46281 [ATES-AN-86/466] p 79 N87-24530 SUPERSONIC FLUTTER Design and demonstrate the performance of cryogenic The effect of circumferential aerodynamic detuning on p 128 N87-20625 components representative of space vehicles: Start basket coupled bending-torsion unstalled supersonic flutter Panel report on new approaches to calibration and liquid acquisition device performance analysis [ASME PAPER 86-GT-100] p 166 A87-25396 [NASA-CR-179138] validation --- Columbus polar platforms p 97 N87-26081 SUPPLYING Operation of the orbital spacecraft consumables resupply system (OSCRS) at the Space Station p 157 N87-20638 SYSTEMS INTEGRATION Space Station integration and verification concepts SYNCHRONOUS SATELLITES Structural design and component tests of large [AIAA PAPER 87-1768] p 84 A87-31461 p 135 A87-45192 geostationary satellite bus Control augmented structural synthesis with transient p 144 A87-32335 SUPPORT SYSTEMS response constraints The Space Station software support environment - Not The evolution of the geostationary platform concept [AIAA PAPER 87-0749] p 56 A87-33573 just what, but why p 125 A87-43154 Integrated air revitalization system for Space Station [AIAA PAPER 87-2208] p 114 A87-48593 SYNTHETIC APERTURE RADAR [SAE PAPER 860946] p 48 A87-38733 SUPPORTS Carbon fibre slotted waveguide arrays Integrated waste and water management system A microgravity isolation mount p 85 A87-41302 p 161 N87-29861 [SAE PAPER 860996] p 51 A87-38773 SURFACE DISTORTION The Earth Observing System (EOS) synthetic aperture ESA's future integrated space data system Quasi-static shape adjustment of a 15 meter diameter radar (SAR) p 126 A87-44187 [AIAA PAPER 87-2190] p 153 A87-48578 space antenna Summary of recent SAR instrument studies

for Space Station

p 113 A87-48588

Data capture and processing -

[AIAA PAPER 87-2203]

p 159 N87-27865

Integrated scheduling and resource management for	Development of an emulation-simulation thermal control	Infrared test technique validation on the Olympus
Space Station Information System	model for space station application [NASA-CR-180312] p 45 N87-26936	satellite [SAE PAPER 860939] p 150 A87-38728
[AIAA PAPER 87-2213] p 119 A87-48597 Space Station Information System integrated	[NASA-CR-180312] p 45 N87-26936 Alternative power generation concepts for space	Regenerable non-venting thermal control subsystem for
communications concept	p 81 N87-28961	extravehicular activity [SAF PAPER 860947] p 42 A87-38734
[AIAA PAPER 87-2228] p 114 A87-48606	High power solar array technologies Columbus space	[SAE PAPER 860947] p 42 A87-38734 Enhanced evaporative surface for two-phase mounting
Space Station Information System requirements for	station p 82 N87-28976	plates
integrated communications [AIAA PAPER 87-2229] p 114 A87-48607	GaAs concentrator solar arrays p 82 N87-28977	[SAE PAPER 860979] p 42 A87-38760
Advanced EVA system design requirements study:	Advanced Solar GaAs Array (ASGA) experiment on EURECA: Flight objectives and instrument configuration	Evaluation of Space Station thermal control techniques
EVAS/space station system interface requirements	p 83 N87-28985	[SAE PAPER 860998] p 42 A87-38775
[NASA-CR-171981] p 120 N87-20351	TECHNOLOGY TRANSFER	Maintenance components for Space Station long life
Qualification of the faint object camera p 127 N87-20359	The Oak Ridge National Laboratory's Robotics and	fluid systems
Commit your works to the Lord, and your thoughts shall	Intelligent Systems Program [DE87-004627] p 101 N87-20774	[SAE PAPER 861005] p 89 A87-38778 Space station active thermal control system modelling
be established (Prov. 16:3). Inter-stable control systems	TECHNOLOGY UTILIZATION	[AIAA PAPER 87-1468] p 43 A87-43003
p 9 N87-22716	NASA's space program - Space Station: A status report	The benefit of phase change thermal storage for
KSC Space Station Operations Language (SSOL) p 138 N87-29168	and a view of its value for space science	spacecraft thermal management [AIAA PAPER 87-1482] p 43 A87-43014
SYSTEMS SIMULATION	p 1 A87-32277	[AIAA PAPER 87-1482] p 43 A87-43014 The definition of the low earth orbital environment and
Attitude and Orientation System (AOCS) tasks on	The use of multidimensional scaling for facilities layout - An application to the design of the Space Station	its effect on thermal control materials
Rendezvous and Docking (RVD) (docking-undocking phases). Architecture of the whole simulator, volume 2	p 118 A87-33003	[AIAA PAPER 87-1599] p 43 A87-43103
[LP-RP-Al-204-VOL-2] p 68 N87-24490	A survey of tether applications to planetary exploration	Thermal test results of the two-phase thermal bus
SYSTEMS STABILITY	[AAS PAPER 86-206] p 123 A87-38568	technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125
Evaluation of constraint stabilization procedures for	Technology and applications - Convergence to a tether	Development of a prototype two-phase thermal bus
multibody dynamical systems [AIAA PAPER 87-0927] p 7 A87-33728	capability [AAS PAPER 86-244] p 124 A87-38574	system for Space Station
Stability of time varying linear systems	A Space Station utility - Static Feed Electrolyzer	[AIAA PAPER 87-1628] p 44 A87-43126 Development of an emulation-simulation thermal control
p 7 A87-37135	[SAE PAPER 860920] p 47 A87-38712	model for space station application
Joint Optics Structures Experiment (JOSE)	The Space Station - Uses and users	[NASA-CR-181009] p 45 N87-26072
p 34 N87-24497	p 151 A87-40513	Development of an emulation-simulation thermal control
<b>+</b>	European utilization aspects studies space stations p 156 N87-20624	model for space station application [NASA-CR-180312] p 45 N87-26936
Т	Ideas for educational physics experiments in space	Development of an emulation-simulation thermal control
TARGET ACQUISITION	p 130 N87-25033	model for space station application
Rendezvous and docking (RVD) long range RF sensor	Fiber composites in satellites	[NASA-CR-181221] p 45 N87-27702
definition study, executive summary	[MBB-UD-492/86] p 107 N87-25430	TEMPERATURE DISTRIBUTION  Determination of the cross-sectional temperature
[SES/ENG/ES-519/86] p 138 N87-28588	TEFLON (TRADEMARK)	distribution and boiling limitation of a heat pipe
TAXONOMY Distributed computer taxonomy based on O/S	Degradation studies of SMRM teflon p 106 A87-38641	p 40 A87-32175
structure p 116 N87-29127	TELECOMMUNICATION	A thermally-pumped heat transport system p 40 A87-32369
TDR SATELLITES	Multiple Access Ku-band communications subsystem for	Temperature fields due to jet induced mixing in a typical
Feasibility study on 8PSK, QPSK, TFM, by using CLASS for Space Station/TDRSS real measured channel	the Space Station p 84 A87-31462 GLOBECOM '86 - Global Telecommunications	OTV tank
p 113 A87-45485	Conference, Houston, TX, Dec. 1-4, 1986, Conference	[AIAA PAPER 87-2017] p 93 A87-52247
A cost effective 300 Mbps space-to-ground	Record. Volumes 1, 2, & 3 p 169 A87-45476	Analysis of on-orbit thermal characteristics of the 15-meter hoop/column antenna
communications subsystem for the Space Station	The effect of multipath on digital communications	[NASA-TM-89137] p 45 N87-21021
Antenna systems and RF coverage for the Space	systems: With application to space station [AD-A178578] p 86 N87-22876	TEMPERATURE GRADIENTS
Station p 2 A87-45523	TELEMETRY	On the control of flexible structures by applied thermal
Japanese data relay satellite system	SPOT solar array in-orbit deployment results	gradients [AIAA PAPER 87-0887] p 16 A87-33706
[AIAA PAPER 87-2199] p 154 A87-48585 TECHNOLOGICAL FORECASTING	evaluation p 83 N87-28986	Control of flexible structures by applied thermal
		CONTROL OF HEXIBIO OFFICE TO THE PROPERTY OF T
A simulation capability for future space flight	TELEOPERATORS	gradients p 21 A87-39543
A simulation capability for future space flight [SAE PAPER 861784] p 99 A87-32633	TELEOPERATORS Study of actuator for large space manipulator arm p 12 A87-32545	gradients p 21 A87-39543 TERRESTRIAL PLANETS
A simulation capability for future space flight [SAE PAPER 861784] p 99 A87-32633 The European space programme p 150 A87-37962	TELEOPERATORS Study of actuator for large space manipulator arm p 12 A87-32545 System architecture for the telerobotic work system	gradients p 21 A87-39543  TERRESTRIAL PLANETS  Experimentation in planetary geology
A simulation capability for future space flight  [SAE PAPER 861784] p 99 A87-32633  The European space programme p 150 A87-37962  Space Station autonomy - What are the challenges?	TELEOPERATORS Study of actuator for large space manipulator arm p 12 A87-32545 System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32746	gradients p 21 A87-39543  TERRESTRIAL PLANETS  Experimentation in planetary geology p 124 A87-40319
A simulation capability for future space flight [SAE PAPER 861784] p 99 A87-32633 The European space programme p 150 A87-37962 Space Station autonomy - What are the challenges? How can they be met? p 101 A87-53059 Speculations on future opportunities to evolve Brayton	TELEOPERATORS  Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32746 Planning for unanticipated satellite servicing teleoperations p 118 A87-33048	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility
A simulation capability for future space flight  [SAE PAPER 861784]  The European space programme p 150 A87-32633  Space Station autonomy - What are the challenges? How can they be met? p 101 A87-53059  Speculations on future opportunities to evolve Brayton powerplants aboard the space station	TELEOPERATORS  Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32746  Planning for unanticipated satellite servicing teleoperations p 118 A87-33048  Application of a traction-drive 7-degrees-of-freedom	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility p 139 A87-38622
A simulation capability for future space flight [SAE PAPER 861784] The European space programme space Space Station autonomy - What are the challenges? How can they be met? p 101 A87-53059 Speculations on future opportunities to evolve Brayton powerplants aboard the space station [NASA-TM-89863] p 121 N87-23674	Study of actuator for large space manipulator arm p 12 A87-32545 System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32746 Planning for unanticipated satellite servicing teleoperations Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility p 139 A87-38622  Space Station propulsion system test bed and control
A simulation capability for future space flight  [SAE PAPER 861784] The European space programme p 150 A87-32633 The European space programme p 150 A87-37962 Space Station autonomy - What are the challenges? How can they be met? Speculations on future opportunities to evolve Brayton powerplants aboard the space station [NASA-TM-89863] TECHNOLOGY ASSESSMENT	TELEOPERATORS  Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system [AAS PAPER 86-044] Planning for unanticipated teleoperations Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616]  p 101 N87-22231	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility p 139 A87-38622  Space Station propulsion system test bed and control system testing results
A simulation capability for future space flight [SAE PAPER 861784] p 99 A87-32633 The European space programme p 150 A87-37962 Space Station autonomy - What are the challenges? How can they be met? p 101 A87-53059 Speculations on future opportunities to evolve Brayton powerplants aboard the space station [NASA-TM-89863] p 121 N87-23674 TECHNOLOGY ASSESSMENT K.E. Tsiolkovskii and problems in the development of science and technology Russian book	TELEOPERATORS  Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32746  Planning for unanticipated satellite servicing teleoperations Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-22231  Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility p 139 A87-38622  Space Station propulsion system test bed and control system testing results [AIAA PAPER 87-1858] Large space structures testing
A simulation capability for future space flight [SAE PAPER 861784] p 99 A87-32633 The European space programme p 150 A87-37962 Space Station autonomy - What are the challenges? How can they be met? p 101 A87-53059 Speculations on future opportunities to evolve Brayton powerplants aboard the space station [NASA-TM-89863] p 121 N87-23674  TECHNOLOGY ASSESSMENT K.E. Tsiolkovskii and problems in the development of science and technology Russian book p 151 A87-40342	TELEOPERATORS  Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system [AAS PAPER 86-044] Planning for unanticipated satellite servicing p 118 A87-33048 Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233 Telerobotic technology for nuclear and space	gradients
A simulation capability for future space flight [SAE PAPER 861784] p 99 A87-32633 The European space programme p 150 A87-37962 Space Station autonomy - What are the challenges? How can they be met? p 101 A87-53059 Speculations on future opportunities to evolve Brayton powerplants aboard the space station [NASA-TM-89863] p 121 N87-23674 TECHNOLOGY ASSESSMENT K.E. Tsiolkovskii and problems in the development of science and technology Russian book	TELEOPERATORS  Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32746  Planning for unanticipated satellite servicing p 118 A87-33048  Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004516] p 101 N87-22231  Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233  Telerobotic technology for nuclear and space applications	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility p 139 A87-38622  Space Station propulsion system test bed and control system testing results [AIAA PAPER 87-1858] p 91 A87-45255  Large space structures testing [NASA-TM-100306] p 35 N87-24520  Absolute indoor calibration of large area solar cells
A simulation capability for future space flight [SAE PAPER 861784] p 99 A87-32633 The European space programme p 150 A87-37962 Space Station autonomy - What are the challenges? How can they be met? p 101 A87-53059 Speculations on future opportunities to evolve Brayton powerplants aboard the space station [NASA-TM-89863] p 121 N87-23674 TECHNOLOGY ASSESSMENT K.E. Tsiolkovskii and problems in the development of science and technology Russian book p 151 A87-40342 Advanced technology for the Space Station p 120 A87-40353 Thoughts on Europe's future in space	TELEOPERATORS  Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system [AAS PAPER 86-044] Planning for unanticipated satellite servicing teleoperations Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] Traction-drive telerobot for space manipulation [DE87-00536] Telerobotic technology for nuclear and space applications [NASA-CR-180923] P 102 N87-22242 A quantifative comparison of several orbital maneuvering	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility p 139 A87-38622  Space Station propulsion system test bed and control system testing results [AIAA PAPER 87-1858] p 91 A87-45255  Large space structures testing [NASA-TM-100306] p 35 N87-24520  Absolute indoor calibration of large area solar cells p 159 N87-29015
A simulation capability for future space flight  [SAE PAPER 861784] The European space programme p 150 A87-32633 The European space programme p 150 A87-37962 Space Station autonomy - What are the challenges? How can they be met? p 101 A87-53059 Speculations on future opportunities to evolve Brayton powerplants aboard the space station [NASA-TM-89863] p 121 N87-23674  TECHNOLOGY ASSESSMENT  K.E. Tsiolkovskii and problems in the development of science and technology Russian book	TELEOPERATORS  Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system [AAS PAPER 86-044] Planning for unanticipated satellite servicing p 118 A87-33048  Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] Traction-drive telerobot for space manipulation [DE87-005326] Telerobotic technology for nuclear and space applications [NASA-CR-180923] A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair replenishment	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility p 139 A87-38622  Space Station propulsion system test bed and control system testing results [AIAA PAPER 87-1858] p 91 A87-45255 Large space structures testing [NASA-TM-100306] p 35 N87-24520 Absolute indoor calibration of large area solar cells p 159 N87-29015
A simulation capability for future space flight  [SAE PAPER 861784] The European space programme p 150 A87-32633 The European space programme p 150 A87-37962 Space Station autonomy - What are the challenges? How can they be met? p 101 A87-53059 Speculations on future opportunities to evolve Brayton powerplants aboard the space station [NASA-TM-89863] p 121 N87-23674  TECHNOLOGY ASSESSMENT  K.E. Tsiolkovskii and problems in the development of science and technology Russian book	TELEOPERATORS  Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32746  Planning for unanticipated satellite servicing p 118 A87-33048  Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-22231  Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233  Telerobotic technology for nuclear and space applications [NASA-CR-180923] p 102 N87-22242  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment (AD-A179106] p 161 N87-23677	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility p 139 A87-38622  Space Station propulsion system test bed and control system testing results [AIAA PAPER 87-1858] p 91 A87-45255  Large space structures testing [NASA-TM-100306] p 35 N87-24520 Absolute indoor calibration of large area solar cells p 159 N87-29015  TETHERED SATELLITES Hollow cathode-based plasma contactor experiments for electrodynamic tether
A simulation capability for future space flight  [SAE PAPER 861784] p9 9 A87-32633  The European space programme p 150 A87-37962  Space Station autonomy - What are the challenges? How can they be met? p 101 A87-53059  Speculations on future opportunities to evolve Brayton powerplants aboard the space station  [NASA-TM-89863] p 121 N87-23674  TECHNOLOGY ASSESSMENT  K.E. Tsiolkovskii and problems in the development of science and technology Russian book  p 151 A87-40342  Advanced technology for the Space Station  p 120 A87-40353  Thoughts on Europe's future in space  p 151 A87-41219  Priorities and policy analysis - A response to Alex Roland  p 168 A87-41222	TELEOPERATORS  Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system [AAS PAPER 86-044] Planning for unanticipated satellite servicing teleoperations Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] Traction-drive telerobot for space manipulation [DE87-005326] Description p 102 N87-22231 Telerobotic technology for nuclear and space applications [NASA-CR-180923] P 102 N87-22242 A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] Self-calibration strategies for robot manipulators	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility p 139 A87-38622  Space Station propulsion system test bed and control system testing results [AIAA PAPER 87-1858] p 91 A87-45255  Large space structures testing [NASA-TM-100306] p 35 N87-24520 Absolute indoor calibration of large area solar cells p 159 N87-29015  TETHERED SATELLITES Hollow cathode-based plasma contactor experiments for electrodynamic tether [AIAA PAPER 87-0572] p 121 A87-32192
A simulation capability for future space flight  [SAE PAPER 861784] p 99 A87-32633  The European space programme p 150 A87-37962  Space Station autonomy - What are the challenges? How can they be met? p 101 A87-53059  Speculations on future opportunities to evolve Brayton powerplants aboard the space station  [NASA-TM-89863] p 121 N87-23674  TECHNOLOGY ASSESSMENT  K.E. Tsiolkovskii and problems in the development of science and technology Russian book p 151 A87-40342  Advanced technology for the Space Station p 120 A87-40353  Thoughts on Europe's future in space p 151 A87-41219  Priorities and policy analysis - A response to Alex Roland p 168 A87-41222  The Space Station overview p 168 A87-41571	TELEOPERATORS  Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32746  Planning for unanticipated satellite servicing p 118 A87-33048  Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-22231  Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233  Telerobotic technology for nuclear and space applications [NASA-CR-180923] p 102 N87-22242  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  Self-calibration strategies for robot manipulators p 102 N87-26355  Telerobotic work system: Concept development and	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility p 139 A87-38622  Space Station propulsion system test bed and control system testing results [AIAA PAPER 87-1858] p 91 A87-45255 Large space structures testing [NASA-TM-100306] p 35 N87-24520 Absolute indoor calibration of large area solar cells Absolute indoor calibration of large area solar cells TETHERED SATELLITES Hollow cathode-based plasma contactor experiments for electrodynamic tether [AIAA PAPER 87-0572] p 121 A87-32192 Some approximations for the dynamics of spacecraft
A simulation capability for future space flight  [SAE PAPER 861784] The European space programme p 150 A87-32633 The European space programme p 150 A87-37962 Space Station autonomy - What are the challenges? How can they be met? p 101 A87-53059 Speculations on future opportunities to evolve Brayton powerplants aboard the space station [NASA-TM-89863] p 121 N87-23674  TECHNOLOGY ASSESSMENT  K.E. Tsiolkovskii and problems in the development of science and technology Russian book	Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system (AAS PAPER 86-044) p 99 A87-32746  Planning for unanticipated satellitie servicing p 118 A87-33048  Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-22231  Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233  Telerobotic technology for nuclear and space applications [NASA-CR-180923] p 102 N87-22242  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  Self-calibration strategies for robot manipulators p 102 N87-26355  Telerobotic work system: Concept development and evolution p 104 N87-29866	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility p 139 A87-38622  Space Station propulsion system test bed and control system testing results [AIAA PAPER 87-1858] p 91 A87-45255  Large space structures testing [NASA-TM-100306] p 35 N87-24520  Absolute indoor calibration of large area solar cells p 159 N87-29015  TETHERED SATELLITES Hollow cathode-based plasma contactor experiments for electrodynamic tether [AIAA PAPER 87-0572] p 121 A87-32192  Some approximations for the dynamics of spacecraft tethers
A simulation capability for future space flight [SAE PAPER 861784] p 9 9 A87-32633 The European space programme p 150 A87-37962 Space Station autonomy - What are the challenges? How can they be met? p 101 A87-53059 Speculations on future opportunities to evolve Brayton powerplants aboard the space station [NASA-TM-89863] p 121 N87-23674 TECHNOLOGY ASSESSMENT K.E. Tsiolkovskii and problems in the development of science and technology Russian book p 151 A87-40342 Advanced technology for the Space Station p 120 A87-40353 Thoughts on Europe's future in space p 151 A87-41219 Priorities and policy analysis - A response to Alex Roland p 168 A87-41222 The Space Station overview p 168 A87-41571 Trends in space transportation p 168 A87-41572 Data storage systems technology for the Space Station era	Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32746  Planning for unanticipated satellite servicing p 118 A87-33048  Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-22231  Traction-drive telerobot for space manipulation [DE97-005326] p 102 N87-22233  Telerobotic technology for nuclear and space applications [NASA-CR-180923] p 102 N87-22242  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  Self-calibration strategies for robot manipulators p 102 N87-26355  Telerobotic work system: Concept development and evolution p 104 N87-29866  Traction-drive, seven-degree-of-freedom telerobot arm:	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility p 139 A87-38622  Space Station propulsion system test bed and control system testing results [AIAA PAPER 87-1858] p 91 A87-45255  Large space structures testing [NASA-TM-100306] p 35 N87-24520 Absolute indoor calibration of large area solar cells p 159 N87-29015  TETHERED SATELLITES Hollow cathode-based plasma contactor experiments for electrodynamic tether [AIAA PAPER 87-0572] p 121 A87-32192 Some approximations for the dynamics of spacecraft tethers [AIAA PAPER 87-0821] p 122 A87-33687
A simulation capability for future space flight  [SAE PAPER 861784] The European space programme p 150 A87-32633 The European space programme p 150 A87-37962 Space Station autonomy - What are the challenges? How can they be met? p 101 A87-53059 Speculations on future opportunities to evolve Brayton powerplants aboard the space station [NASA-TM-89863] p 121 N87-23674  TECHNOLOGY ASSESSMENT  K.E. Tsiolkovskii and problems in the development of science and technology Russian book	Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32746  Planning for unanticipated satellite servicing teleoperations p 118 A87-33048  Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004516] p 101 N87-22231  Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233  Telerobotic technology for nuclear and space applications [NASA-CR-180923] p 102 N87-22242  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  Self-calibration strategies for robot manipulators p 104 N87-29867  Telerobotic work system: Concept development and evolution Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility p 139 A87-38622 Space Station propulsion system test bed and control system testing results [AIAA PAPER 87-1858] p 91 A87-45255 Large space structures testing [NASA-TM-100306] p 35 N87-24520 Absolute indoor calibration of large area solar cells p 159 N87-29015  TETHERED SATELLITES Hollow cathode-based plasma contactor experiments for electrodynamic tether [AIAA PAPER 87-0572] p 121 A87-32192 Some approximations for the dynamics of spacecraft tethers [AIAA PAPER 87-0821] p 122 A87-33687 Tethers in space; Proceedings of the International Conference, Arlington, VA, Sept. 17-19, 1986
A simulation capability for future space flight  [SAE PAPER 861784] p9 9 A87-32633  The European space programme p 150 A87-37962  Space Station autonomy - What are the challenges? How can they be met? p101 A87-53059  Speculations on future opportunities to evolve Brayton powerplants aboard the space station  [NASA-TM-89863] p121 N87-23674  TECHNOLOGY ASSESSMENT  K.E. Tsiolkovskii and problems in the development of science and technology Russian book  p 151 A87-40342  Advanced technology for the Space Station  p 120 A87-40353  Thoughts on Europe's future in space  p 151 A87-41219  Priorities and policy analysis - A response to Alex Roland  The Space Station overview p 168 A87-41521  Data storage systems technology for the Space Station era  [AIAA PAPER 87-2202] p 113 A87-48587  Analysis and implementation of automation aspects in	Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32746  Planning for unanticipated satellite servicing p 118 A87-33048  Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-22231  Traction-drive telerobot for space manipulation p 102 N87-22233  Telerobotic technology for nuclear and space applications [NASA-CR-180923] p 102 N87-22242  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 101 N87-23677  Self-calibration strategies for robot manipulators p 102 N87-26355  Telerobotic work system: Concept development and evolution p 104 N87-29866  Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867  TEMPERATURE CONTROL  Thermal verification method for large sized spacecraft	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility p 139 A87-38622  Space Station propulsion system test bed and control system testing results [AIAA PAPER 87-1858] p 91 A87-45255  Large space structures testing [NASA-TM-100306] p 35 N87-24520 Absolute indoor calibration of large area solar cells p 159 N87-29015  TETHERED SATELLITES Hollow cathode-based plasma contactor experiments for electrodynamic tether [AIAA PAPER 87-0572] p 121 A87-32192 Some approximations for the dynamics of spacecraft tethers [AIAA PAPER 87-0821] p 122 A87-33687 Tethers in space; Proceedings of the International Conference, Arlington, VA, Sept. 17-19, 1986 p 123 A87-38567
A simulation capability for future space flight  [SAE PAPER 861784] p9 9 A87-32633  The European space programme p 150 A87-37962  Space Station autonomy - What are the challenges? How can they be met? p101 A87-53059  Speculations on future opportunities to evolve Brayton powerplants aboard the space station  [NASA-TM-89863] p121 N87-23674  TECHNOLOGY ASSESSMENT  K.E. Tsiolkovskii and problems in the development of science and technology Russian book  p 151 A87-40342  Advanced technology for the Space Station  p 120 A87-40353  Thoughts on Europe's future in space  p 151 A87-41219  Priorities and policy analysis - A response to Alex Roland  The Space Station overview p 168 A87-41222  The Space Station overview p 168 A87-41571  Trends in space transportation p 168 A87-41572  Data storage systems technology for the Space Station era  [AIAA PAPER 87-2202] p 113 A87-48587  Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems	Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32746  Planning for unanticipated satellitie servicing p 118 A87-33048  Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004516] p 101 N87-22231  Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233  Telerobotic technology for nuclear and space applications [NASA-CR-180923] p 102 N87-22242  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  Self-calibration strategies for robot manipulators p 102 N87-26355  Telerobotic work system: Concept development and evolution p 104 N87-29866  Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867  TEMPERATURE CONTROL  Thermal verification method for large sized spacecraft p 144 A87-32368	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility p 139 A87-38622  Space Station propulsion system test bed and control system testing results [AIAA PAPER 87-1858] p 91 A87-45255  Large space structures testing [NASA-TM-100306] p 35 N87-24520 Absolute indoor calibration of large area solar cells p 159 N87-29015  TETHERED SATELLITES Hollow cathode-based plasma contactor experiments for electrodynamic tether [AIAA PAPER 87-0572] p 121 A87-32192 Some approximations for the dynamics of spacecraft tethers [AIAA PAPER 87-0821] p 122 A87-33687 Tethers in space; Proceedings of the International Conference, Arlington, VA, Sept. 17-19, 1986 p 123 A87-38567 Tethered satellite program control strategy
A simulation capability for future space flight  [SAE PAPER 861784] p 99 A87-32633  The European space programme p 150 A87-37962  Space Station autonomy - What are the challenges? How can they be met? p 101 A87-53059  Speculations on future opportunities to evolve Brayton powerplants aboard the space station  [NASA-TM-89863] p 121 N87-23674  TECHNOLOGY ASSESSMENT  K.E. Tsiolkovskii and problems in the development of science and technology Russian book  p 151 A87-40342  Advanced technology for the Space Station  p 120 A87-40353  Thoughts on Europe's future in space  p 151 A87-41219  Priorities and policy analysis - A response to Alex Roland  The Space Station overview p 168 A87-41571  Trends in space transportation p 168 A87-41572  Data storage systems technology for the Space Station era  [AIAA PAPER 87-2202] p 113 A87-48587  Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems  [AIAA PAPER 87-2210] p 154 A87-48595	Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32746  Planning for unanticipated satellitie servicing p 118 A87-33048  Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-22231  Traction-drive telerobot for space manipulation [DE87-00536] p 102 N87-22233  Telerobotic technology for nuclear and space applications [NASA-CR-180923] p 102 N87-22242  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 101 N87-23677  Self-calibration strategies for robot manipulators p 102 N87-26355  Telerobotic work system: Concept development and evolution p 104 N87-29667  Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867  TEMPERATURE CONTROL  Thermal verification method for large sized spacecraft p 144 A87-32368  Development of fluid loop system for spacecraft p 144 A87-32370	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility p 139 A87-38622  Space Station propulsion system test bed and control system testing results [AIAA PAPER 87-1858] p 91 A87-45255 Large space structures testing [NASA-TM-100306] p 35 N87-24520 Absolute indoor calibration of large area solar cells p 159 N87-29015  TETHERED SATELLITES Hollow cathode-based plasma contactor experiments for electrodynamic tether [AIAA PAPER 87-0572] p 121 A87-32192 Some approximations for the dynamics of spacecraft tethers [AIAA PAPER 87-0821] p 122 A87-33687 Tethers in space; Proceedings of the International Conference, Arlington, VA, Sept. 17-19, 1986 p 123 A87-38567  Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570
A simulation capability for future space flight  [SAE PAPER 861784] p9 9 A87-32633  The European space programme p 150 A87-37962  Space Station autonomy - What are the challenges?  How can they be met? p101 A87-53059  Speculations on future opportunities to evolve Brayton powerplants aboard the space station  [NASA-TM-89863] p121 N87-23674  TECHNOLOGY ASSESSMENT  K.E. Tsiolkovskii and problems in the development of science and technology Russian book  p 151 A87-40342  Advanced technology for the Space Station  p 120 A87-40353  Thoughts on Europe's future in space  p 151 A87-41219  Priorities and policy analysis - A response to Alex Roland  The Space Station overview p 168 A87-41521  Data storage systems technology for the Space Station era  [AIAA PAPER 87-2202] p 113 A87-48587  Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems  [AIAA PAPER 87-2210] p 154 A87-48595  An advanced technology space station for the year 2025, study and concepts	Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32746  Planning for unanticipated satellitie servicing p 118 A87-33048  Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-22231  Traction-drive telerobot for space manipulation p 102 N87-22233  Telerobotic technology for nuclear and space applications [NASA-CR-180923] p 102 N87-22242  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 101 N87-23677  Self-calibration strategies for robot manipulators p 102 N87-26355  Telerobotic work system: Concept development and evolution Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulator in space p 104 N87-29867  TEMPERATURE CONTROL Thermal verification method for large sized spacecraft p 144 A87-32368  Development of fluid loop system for spacecraft p 144 A87-32370  High thermal capacity evaporator and condensers for	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility p 139 A87-38622  Space Station propulsion system test bed and control system testing results [AIAA PAPER 87-1858] p 91 A87-45255  Large space structures testing [NASA-TM-100306] p 35 N87-24520 Absolute indoor calibration of large area solar cells p 159 N87-29015  TETHERED SATELLITES Hollow cathode-based plasma contactor experiments for electrodynamic tether [AIAA PAPER 87-0572] p 121 A87-32192 Some approximations for the dynamics of spacecraft tethers [AIAA PAPER 87-0821] p 122 A87-33687 Tethers in space; Proceedings of the International Conference, Arlington, VA, Sept. 17-19, 1986 p 123 A87-38567 Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570 Technology and applications - Convergence to a tether capability
A simulation capability for future space flight  [SAE PAPER 861784] p 99 A87-32633  The European space programme p 150 A87-37962  Space Station autonomy - What are the challenges? How can they be met? p 101 A87-53059  Speculations on future opportunities to evolve Brayton powerplants aboard the space station  [NASA-TM-89863] p 121 N87-23674  TECHNOLOGY ASSESSMENT  K.E. Tsiolkovskii and problems in the development of science and technology Russian book  p 151 A87-40342  Advanced technology for the Space Station  p 120 A87-40353  Thoughts on Europe's future in space  p 151 A87-41219  Priorities and policy analysis - A response to Alex Roland  The Space Station overview p 168 A87-41571  Trends in space transportation p 168 A87-41572  Data storage systems technology for the Space Station era  [AIAA PAPER 87-2202] p 113 A87-48587  Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems  [AIAA PAPER 87-2210] p 154 A87-48595  An advanced technology space station for the year 2025, study and concepts  [NASA-CR-178208] p 120 N87-20340	Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32746  Planning for unanticipated satellite servicing p 118 A87-33048  Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation  [DE87-004616] p 101 N87-22231  Traction-drive telerobot for space manipulation  [DE87-005326] p 102 N87-22233  Telerobotic technology for nuclear and space applications  [NASA-CR-180923] p 102 N87-22242  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] self-calibration strategies for robot manipulators p 102 N87-26355  Telerobotic work system: Concept development and evolution p 104 N87-29866  Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulation in space p 104 N87-29867  TEMPERATURE CONTROL  Thermal verification method for large sized spacecraft p 144 A87-32376  High thermal capacity evaporator and condensers for Space Station thermal control p 41 A87-32377	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility p 139 A87-38622  Space Station propulsion system test bed and control system testing results [AIAA PAPER 87-1858] p 91 A87-45255  Large space structures testing [NASA-TM-100306] p 35 N87-24520 Absolute indoor calibration of large area solar cells p 159 N87-29015  TETHERED SATELLITES Hollow cathode-based plasma contactor experiments for electrodynamic tether [AIAA PAPER 87-0572] p 121 A87-32192 Some approximations for the dynamics of spacecraft tethers [AIAA PAPER 87-0821] p 122 A87-33687 Tethers in space; Proceedings of the International Conference, Arlington, VA, Sept. 17-19, 1986 p 123 A87-38570 Tethnology and applications - Convergence to a tether capability [AAS PAPER 86-244] p 124 A87-38574
A simulation capability for future space flight  [SAE PAPER 861784] p 99 A87-32633  The European space programme p 150 A87-37962  Space Station autonomy - What are the challenges? How can they be met? p 101 A87-53059  Speculations on future opportunities to evolve Brayton powerplants aboard the space station  [NASA-TM-89863] p 121 N87-23674  TECHNOLOGY ASSESSMENT  K.E. Tsiolkovskii and problems in the development of science and technology Russian book  p 151 A87-40342  Advanced technology for the Space Station  p 120 A87-40353  Thoughts on Europe's future in space  p 151 A87-41219  Priorities and policy analysis - A response to Alex Aland  Trends in space transportation  p 168 A87-41571  Trends in space transportation  p 168 A87-41572  Data storage systems technology for the Space Station era  [AIAA PAPER 87-2202] p 113 A87-48587  Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems  [AIAA PAPER 87-2210] p 154 A87-48595  An advanced technology space station for the year 2025, study and concepts  [NASA-CR-178208] p 120 N87-20340  Experiment	Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32746  Planning for unanticipated satellitie servicing p 118 A87-33048  Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-22231  Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233  Telerobotic technology for nuclear and space applications [NASA-CR-180923] p 102 N87-22242  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 101 N87-23677  Self-calibration strategies for robot manipulators p 102 N87-26355  Telerobotic work system: Concept development and evolution p 104 N87-29866  Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867  TEMPERATURE CONTROL  Thermal verification method for large sized spacecraft p 144 A87-32368  Development of fluid loop system for spacecraft p 144 A87-32370  High thermal capacity evaporator and condensers for Space Station thermal totals of a two-phase thermal	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility p 139 A87-38622  Space Station propulsion system test bed and control system testing results [AIAA PAPER 87-1858] p 91 A87-45255  Large space structures testing [NASA-TM-100306] p 35 N87-24520 Absolute indoor calibration of large area solar cells p 159 N87-29015  TETHERED SATELLITES Hollow cathode-based plasma contactor experiments for electrodynamic tether [AIAA PAPER 87-0572] p 121 A87-32192 Some approximations for the dynamics of spacecraft tethers [AIAA PAPER 87-0821] p 122 A87-33687 Tethers in space; Proceedings of the International Conference, Arlington, VA, Sept. 17-19, 1986 p 123 A87-38567 Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570 Technology and applications - Convergence to a tether capability [AAS PAPER 86-244] p 124 A87-38574 The Tethered Satellite System as a new remote sensing
A simulation capability for future space flight  [SAE PAPER 861784] p9 9 A87-32633  The European space programme p150 A87-37962  Space Station autonomy - What are the challenges?  How can they be met? p101 A87-53059  Speculations on future opportunities to evolve Brayton powerplants aboard the space station  [NASA-TM-89863] p121 N87-23674  TECHNOLOGY ASSESSMENT  K.E. Tsiolkovskii and problems in the development of science and technology Russian book  p 151 A87-40342  Advanced technology for the Space Station  p 120 A87-40353  Thoughts on Europe's future in space  p 151 A87-41219  Priorities and policy analysis - A response to Alex Roland  The Space Station overview p168 A87-41521  Data storage systems technology for the Space Station era  [AIAA PAPER 87-2202] p 113 A87-48587  Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems  [AIAA PAPER 87-2210] p 113 A87-48595  An advanced technology space station for the year 2025, study and concepts  [NASA-CR-178208] p 120 N87-20340  Cryogenic Fluid Management  Fight Experiment  p 95 N87-21150	Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32746  Planning for unanticipated satellite servicing p 118 A87-33048  Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation  [DE87-004616] p 101 N87-22231  Traction-drive telerobot for space manipulation  [DE87-005326] p 102 N87-22233  Telerobotic technology for nuclear and space applications  [NASA-CR-180923] p 102 N87-22242  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] self-calibration strategies for robot manipulators  Felerobotic work system: Concept development and evolution p 104 N87-29866  Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867  TEMPERATURE CONTROL  Thermal verification method for large sized spacecraft p 144 A87-32370  High thermal capacity evaporator and condensers for Space Station thermal control p 41 A87-32377  Development status of a two-phase thermal management system for large spacecraft [SAE PAPER 861828]	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility p 139 A87-38622  Space Station propulsion system test bed and control system testing results [AIAA PAPER 87-1858] p 91 A87-45255  Large space structures testing [NASA-TM-100306] p 35 N87-24520  Absolute indoor calibration of large area solar cells p 159 N87-29015  TETHERED SATELLITES Hollow cathode-based plasma contactor experiments for electrodynamic tether [AIAA PAPER 87-0572] p 121 A87-32192 Some approximations for the dynamics of spacecraft tethers [AIAA PAPER 87-0821] p 122 A87-33687 Tethers in space; Proceedings of the International Conference, Arlington, VA, Sept. 17-19, 1986 p 123 A87-38567  Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570 Technology and applications - Convergence to a tether capability [AAS PAPER 86-244] p 124 A87-38574 The Tethered Satellite System as a new remote sensing platform p 124 A87-39183
A simulation capability for future space flight  [SAE PAPER 861784] The European space programme p 150 A87-32633 The European space programme p 150 A87-37962 Space Station autonomy - What are the challenges? How can they be met? p 101 A87-53059 Speculations on future opportunities to evolve Brayton powerplants aboard the space station [NASA-TM-89863] p 121 N87-23674  TECHNOLOGY ASSESSMENT  K.E. Tsiolkovskii and problems in the development of science and technology Russian book	Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32746  Planning for unanticipated satellitie servicing p 118 A87-33048  Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-22231  Traction-drive telerobot for space manipulation p 102 N87-22233  Telerobotic technology for nuclear and space applications [NASA-CR-180923] p 102 N87-22242  Aquantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 101 N87-22637  Self-calibration strategies for robot manipulators p 102 N87-26355  Telerobotic work system: Concept development and evolution Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulator in space p 104 N87-29867  TEMPERATURE CONTROL  Thermal verification method for large sized spacecraft p 144 A87-32368  Development of fluid loop system for spacecraft p 144 A87-32370  High thermal capacity evaporator and condensers for Space Station thermal control p 41 A87-32377  Development status of a two-phase thermal management system for large spacecraft	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility p 139 A87-38622  Space Station propulsion system test bed and control system testing results [AIAA PAPER 87-1858] p 91 A87-45255  Large space structures testing [NASA-TM-100306] p 35 N87-24520 Absolute indoor calibration of large area solar cells p 159 N87-29015  TETHERED SATELLITES Hollow cathode-based plasma contactor experiments for electrodynamic tether [AIAA PAPER 87-0572] p 121 A87-32192 Some approximations for the dynamics of spacecraft tethers [AIAA PAPER 87-0821] p 122 A87-33687 Tethers in space; Proceedings of the International Conference, Arlington, VA, Sept. 17-19, 1986 p 123 A87-38567 Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570 Technology and applications - Convergence to a tether capability [AAS PAPER 86-244] p 124 A87-38574 The Tethered Satellite System as a new remote sensing
A simulation capability for future space flight  [SAE PAPER 861784] p9 9 A87-32633  The European space programme p150 A87-37962  Space Station autonomy - What are the challenges?  How can they be met? p101 A87-53059  Speculations on future opportunities to evolve Brayton powerplants aboard the space station  [NASA-TM-89863] p121 N87-23674  TECHNOLOGY ASSESSMENT  K.E. Tsiolkovskii and problems in the development of science and technology Russian book  p 151 A87-40342  Advanced technology for the Space Station  p 120 A87-40353  Thoughts on Europe's future in space  p 151 A87-41219  Priorities and policy analysis - A response to Alex Roland  The Space Station overview p168 A87-41521  Data storage systems technology for the Space Station era  [AIAA PAPER 87-2202] p 113 A87-48587  Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems  [AIAA PAPER 87-2210] p 113 A87-48595  An advanced technology space station for the year 2025, study and concepts  [NASA-CR-178208] p 120 N87-20340  Cryogenic Fluid Management  Fight Experiment  p 95 N87-21150	Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32746  Planning for unanticipated satellitie servicing p 118 A87-33048  Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-22231  Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233  Telerobotic technology for nuclear and space applications [NASA-CR-180923] p 102 N87-22242  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 102 N87-26355  Telerobotic work system: Concept development and evolution p 104 N87-29667  Telerobotic work system: Concept development and evolution p 104 N87-29867  Telerobotic mork system: Concept development and evolution p 104 N87-29867  Temperature Control.  Thermal verification method for large sized spacecraft p 144 A87-32368  Development of fluid loop system for spacecraft p 144 A87-32370  High thermal capacity evaporator and condensers for Space Station thermal control p 41 A87-32377  Development status of a two-phase thermal management system for large spacecraft [SAE PAPER 861828] p 41 A87-32662  Prototype thermal bus for manned Space Station compartments	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility p 139 A87-38622  Space Station propulsion system test bed and control system testing results [AIAA PAPER 87-1858] p 91 A87-45255  Large space structures testing [NASA-TM-100306] p 35 N87-24520  Absolute indoor calibration of large area solar cells p 159 N87-29015  TETHERED SATELLITES Hollow cathode-based plasma contactor experiments for electrodynamic tether [AIAA PAPER 87-0572] p 121 A87-32192  Some approximations for the dynamics of spacecraft tethers [AIAA PAPER 87-0821] p 122 A87-33687  Tethers in space; Proceedings of the International Conference, Arlington, VA, Sept. 17-19, 1986 p 123 A87-38567  Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  Technology and applications - Convergence to a tether capability [AAS PAPER 86-244] p 124 A87-39183  Deployment dynamics of space structures p 58 A87-40074 Orbital modifications using forced tether-length
A simulation capability for future space flight [SAE PAPER 861784] p9 9 A87-32633 The European space programme p 150 A87-37962 Space Station autonomy - What are the challenges? How can they be met? p101 A87-53059 Speculations on future opportunities to evolve Brayton powerplants aboard the space station [NASA-TM-89863] p121 N87-23674  TECHNOLOGY ASSESSMENT K.E. Tsiolkovskii and problems in the development of science and technology Russian book p 151 A87-40342 Advanced technology for the Space Station p 120 A87-40353  Thoughts on Europe's future in space p 151 A87-41219 Priorities and policy analysis - A response to Alex Roland The Space Station overview p 168 A87-41222 The Space Station overview p 168 A87-41571 Trends in space transportation p 168 A87-41572 Data storage systems technology for the Space Station era [AIAA PAPER 87-2202] p 113 A87-48587 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210] p 113 A87-48595 An advanced technology space station for the year 2025, study and concepts [NASA-CR-178208] p 120 N87-20340 Cryogenic Fluid Management (CFMFE) System technology analysis of aeroassisted orbital transfer vehicles: Moderate lift/drag (0.75-1.5). Volume 2 Supporting research and technology report, phase 1 and 2	Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system (AAS PAPER 86-044) p 99 A87-32746  Planning for unanticipated satellite servicing p 118 A87-33048  Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation  [DE87-004616] p 101 N87-22231  Traction-drive telerobot for space manipulation  [DE87-005326] p 102 N87-22233  Telerobotic technology for nuclear and space applications  [NASA-CR-180923] p 102 N87-22242  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  Self-calibration strategies for robot manipulators p 102 N87-26355  Telerobotic work system: Concept development and evolution p 104 N87-29866  Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867  TEMPERATURE CONTROL  Thermal verification method for large sized spacecraft p 144 A87-32370  High thermal capacity evaporator and condensers for Space Station thermal control p 41 A87-32370  Development status of a two-phase thermal management system for large spacecraft [SAE PAPER 861825] p 41 A87-3268	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility p 139 A87-38622  Space Station propulsion system test bed and control system testing results [AIAA PAPER 87-1858] p 91 A87-45255  Large space structures testing [NASA-TM-100306] p 35 N87-24520  Absolute indoor calibration of large area solar cells p 159 N87-29015  TETHERED SATELLITES Hollow cathode-based plasma contactor experiments for electrodynamic tether [AIAA PAPER 87-0572] p 121 A87-32192 Some approximations for the dynamics of spacecraft tethers [AIAA PAPER 87-0821] p 122 A87-33687 Tethers in space; Proceedings of the International Conference, Arlington, VA, Sept. 17-19, 1986 p 123 A87-38567  Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570 Technology and applications - Convergence to a tether capability [AAS PAPER 86-244] p 124 A87-38574 The Tethered Satellite System as a new remote sensing platform p 124 A87-39183 Deployment dynamics of space structures p 58 A87-40074 Orbital modifications using forced tether-length variations
A simulation capability for future space flight  [SAE PAPER 861784] p 99 A87-32633  The European space programme p 150 A87-37962  Space Station autonomy - What are the challenges? How can they be met? p 101 A87-53059  Speculations on future opportunities to evolve Brayton powerplants aboard the space station  [NASA-TM-89863] p 121 N87-23674  TECHNOLOGY ASSESSMENT  K.E. Tsiolkovskii and problems in the development of science and technology Russian book p 151 A87-40342  Advanced technology for the Space Station p 120 A87-40353  Thoughts on Europe's future in space p 151 A87-41219  Priorities and policy analysis - A response to Alex Aland p 168 A87-41221  The Space Station overview p 168 A87-41222  The Space Station overview p 168 A87-41571  Trends in space transportation p 168 A87-41572  Data storage systems technology for the Space Station era  [AIAA PAPER 87-2202] p 113 A87-48587  Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems  [AIAA PAPER 87-2210] p 154 A87-48595  An advanced technology space station for the year 2025, study and concepts  [NASA-CR-178208] p 120 N87-20340  Cryogenic Fluid Management (CFMFE)  System technology analysis of aeroassisted orbital transfer vehicles: Moderate lift/drag (0.75-1.5). Volume 2: Supporting research and technology report, phase 1 and 2  [NASA-CR-179143] p 3 N87-26065	Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32746  Planning for unanticipated satellitie servicing p 118 A87-33048  Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-22231  Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233  Telerobotic technology for nuclear and space applications [NASA-CR-180923] p 102 N87-22242  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 101 N87-23677  Self-calibration strategies for robot manipulators p 102 N87-26355  Telerobotic work system: Concept development and evolution p 104 N87-29667  Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29667  TEMPERATURE CONTROL  Thermal verification method for large sized spacecraft p 144 A87-32368  Development of fluid loop system for spacecraft p 144 A87-32370  High thermal capacity evaporator and condensers for Space Station thermal control p 41 A87-32377  Development status of a two-phase thermal management system for large spacecraft [SAE PAPER 861828] p 41 A87-3268  The capabilities of Eureca thermal control for future mission scenarios	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility p 139 A87-38622  Space Station propulsion system test bed and control system testing results [AIAA PAPER 87-1858] p 91 A87-45255  Large space structures testing [NASA-TM-100306] p 35 N87-24520  Absolute indoor calibration of large area solar cells p 159 N87-29015  TETHERED SATELLITES Hollow cathode-based plasma contactor experiments for electrodynamic tether [AIAA PAPER 87-0572] p 121 A87-32192  Some approximations for the dynamics of spacecraft tethers [AIAA PAPER 87-0821] p 122 A87-33687  Tethers in space; Proceedings of the International Conference, Arlington, VA, Sept. 17-19, 1986 p 123 A87-38567  Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  Technology and applications - Convergence to a tether capability [AAS PAPER 86-244] p 124 A87-38574  The Tethered Satellite System as a new remote sensing platform p 124 A87-39183  Deployment dynamics of space structures p 58 A87-40074  Orbital modifications using for micro-g/variable-g
A simulation capability for future space flight [SAE PAPER 861784] p9 9 A87-32633 The European space programme p 150 A87-37962 Space Station autonomy - What are the challenges? How can they be met? p101 A87-53059 Speculations on future opportunities to evolve Brayton powerplants aboard the space station [NASA-TM-89863] p121 N87-23674  TECHNOLOGY ASSESSMENT K.E. Tsiolkovskii and problems in the development of science and technology Russian book p 151 A87-40342 Advanced technology for the Space Station p 120 A87-40353  Thoughts on Europe's future in space p 151 A87-41219 Priorities and policy analysis - A response to Alex Roland The Space Station overview p 168 A87-41222 The Space Station overview p 168 A87-41571 Trends in space transportation p 168 A87-41572 Data storage systems technology for the Space Station era [AIAA PAPER 87-2202] p 113 A87-48587 Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210] p 113 A87-48595 An advanced technology space station for the year 2025, study and concepts [NASA-CR-178208] p 120 N87-20340 Cryogenic Fluid Management (CFMFE) System technology analysis of aeroassisted orbital transfer vehicles: Moderate lift/drag (0.75-1.5). Volume 2 Supporting research and technology report, phase 1 and 2	Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system (AAS PAPER 86-044) p 99 A87-32746  Planning for unanticipated satellite servicing p 118 A87-33048  Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation  [DE87-004616] p 101 N87-22231  Traction-drive telerobot for space manipulation  [DE87-005326] p 102 N87-22233  Telerobotic technology for nuclear and space applications  [NASA-CR-180923] p 102 N87-22242  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment (AD-A179106] p 161 N87-23677  Self-calibration strategies for robot manipulators p 102 N87-26355  Telerobotic work system: Concept development and evolution p 104 N87-29866  Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulation in space p 104 N87-29867  TEMPERATURE CONTROL  Thermal verification method for large sized spacecraft p 144 A87-32368  Development of fluid loop system for spacecraft p 144 A87-32370  High thermal capacity evaporator and condensers for Space Station thermal control p 41 A87-32370  Development status of a two-phase thermal management system for large spacecraft [SAE PAPER 861828] p 41 A87-3268  The capabilities of Eureca thermal control for future mission scenarios  [SAE PAPER 860936] p 42 A87-38725	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility p 139 A87-38622  Space Station propulsion system test bed and control system testing results [AIAA PAPER 87-1858] p 91 A87-45255 Large space structures testing [NASA-TM-100306] p 35 N87-24520 Absolute indoor calibration of large area solar cells p 159 N87-29015  TETHERED SATELLITES Hollow cathode-based plasma contactor experiments for electrodynamic tether [AIAA PAPER 87-0572] p 121 A87-32192 Some approximations for the dynamics of spacecraft tethers [AIAA PAPER 87-0821] p 122 A87-33687 Tethers in space; Proceedings of the International Conference, Arlington, VA, Sept. 17-19, 1986 p 123 A87-38567  Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570 Technology and applications - Convergence to a tether capability [AAS PAPER 86-244] p 124 A87-38574 The Tethered Satellite System as a new remote sensing platform p 124 A87-39183 Deployment dynamics of space structures p 58 A87-40074 Orbital modifications using forced tether-length variations p 124 A87-40858 A three-mass tethered system for micro-g/variable-g applications p 125 A87-40858
A simulation capability for future space flight  [SAE PAPER 861784] The European space programme p 150 A87-32633 The European space programme p 150 A87-37962 Space Station autonomy - What are the challenges? How can they be met? p 101 A87-53059 Speculations on future opportunities to evolve Brayton powerplants aboard the space station [NASA-TM-89863] p 121 N87-23674  TECHNOLOGY ASSESSMENT  K.E. Tsiolkovskii and problems in the development of science and technology Russian book	Study of actuator for large space manipulator arm p 12 A87-32545  System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32746  Planning for unanticipated satellitie servicing p 118 A87-33048  Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation [DE87-004616] p 101 N87-22231  Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233  Telerobotic technology for nuclear and space applications [NASA-CR-180923] p 102 N87-22242  A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 101 N87-23677  Self-calibration strategies for robot manipulators p 102 N87-26355  Telerobotic work system: Concept development and evolution p 104 N87-29867  Telerobotic work system: Concept development and evolution p 104 N87-29867  Temperature Control.  Thermal verification method for large sized spacecraft p 144 A87-32368  Development of fluid loop system for spacecraft p 144 A87-32370  High thermal capacity evaporator and condensers for Space Station thermal control p 41 A87-32371  Development status of a two-phase thermal management system for large spacecraft [SAE PAPER 861828] p 41 A87-3268  The capabilities of Eureca thermal control for future mission scenarios	gradients p 21 A87-39543  TERRESTRIAL PLANETS Experimentation in planetary geology p 124 A87-40319  TEST FACILITIES Martin Marietta atomic oxygen beam facility p 139 A87-38622  Space Station propulsion system test bed and control system testing results [AIAA PAPER 87-1858] p 91 A87-45255  Large space structures testing [NASA-TM-100306] p 35 N87-24520  Absolute indoor calibration of large area solar cells p 159 N87-29015  TETHERED SATELLITES Hollow cathode-based plasma contactor experiments for electrodynamic tether [AIAA PAPER 87-0572] p 121 A87-32192  Some approximations for the dynamics of spacecraft tethers [AIAA PAPER 87-0821] p 122 A87-33687  Tethers in space; Proceedings of the International Conference, Arlington, VA, Sept. 17-19, 1986 p 123 A87-38567  Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570  Technology and applications - Convergence to a tether capability [AAS PAPER 86-244] p 124 A87-38574  The Tethered Satellite System as a new remote sensing platform p 124 A87-39183  Deployment dynamics of space structures p 58 A87-40074  Orbital modifications using for micro-g/variable-g

The mission function control for deployment and retrieval Evaluation of the infrared test method for the Olympus THRUST CONTROL thermal balance tests p 44 A87-46682 Preliminary evaluation of a reaction control system for [AIAA PAPER 87-2326] n 126 AR7-50447 THERMAL CONTROL COATINGS the space station p 67 N87-22736 The tethered satellite system for low density erothermodynamics studies p 127 A87-52450 The definition of the low earth orbital environment and Space station structural dynamics/reaction control aerothermodynamics studies its effect on thermal control materials p 67 N87-22753 system interaction study Thermal and dynamical effects on electrodynamic space [AIAA PAPER 87-1599] p 43 A87-43103 THRUST DISTRIBUTION Space stable thermal control coatings Dynamic behavior of astronauts and satellites outside [AD-A180276] [AD-A182796] p 110 N87-28584 p 130 N87-25351 an orbiting space station under the influence of thrust Analytical investigation of the dynamics of tethered THERMAL CYCLING TESTS constellations in Earth orbit, phase 2 p 52 A87-41666 Joint technology for graphite epoxy space structures [NASA-CR-179149] p 130 N87-26083 THRUST PROGRAMMING p 20 A87-38600 Inadequacy of single-impulse transfers for path postrained rendezvous p 90 A87-41615 Electrodynamic tether Assessment of space environment p 131 N87-26449 induced constrained rendezvous TETHERING microdamage in toughened composite materials Tethers in space; Proceedings of the International THRUST VECTOR CONTROL p 20 A87-38609 Conceptual design and integration of a Space Station resistojet propulsion assembly Conference, Arlington, VA, Sept. 17-19, 1986 THERMAL DEGRADATION p 123 A87-38567 Enhancement of solar absorptance degradation due to A survey of tether applications to planetary exploration [AIAA PAPER 87-1860] contamination of solar radiator panels in geosynchronous orbit - Correlation of flight data and laboratory p 91 A87-45256 [AAS PAPER 86-206]
Coaxial tube array space Conceptual design and integration of a space station p 123 resistojet propulsion assembly [NASA-TM-89847] transmission line measurements p 144 A87-32346 characterization Thermal deformation and electrical degradation of p 93 N87-20378 Dynamics during thrust maneuvers of flexible spinning satellites with axial and radial booms p 71 N87-25355 [NASA-TM-89864] p 96 N87-22003 antenna reflector with truss backstructure Investigation of beam-plasma interactions p 12 A87-32405 [NASA-CR-180579] p 129 N87-22508 THERMAL ENERGY TIME MEASUREMENT Optimal shuttle altitude changes using tethers A transient analysis of phase change energy storage Proof that timing requirements of the FDDI token ring [AD-A179205] system for solar dynamic power p 129 N87-22756 p 131 N87-26449 protocol are satisfied --- fiber distributed data interface Electrodynamic tether [AIAA PAPER 87-1469] p 77 A87-43004 D 112 A87-42821 Phase 3 study of selected tether applications in space.

Volume 1: Executive summary Selection of high temperature thermal energy storage TIME SHARING materials for advanced solar dynamic space power On the performance analysis of a real-time distributed [NASA-CR-179185] p 131 N87-29585 computer system p 111 A87-31518 Investigation of plasma contactors for use with orbiting [NASA-TM-89886] p 78 N87-22174 TIMOSHENKO BEAMS THERMAL EXPANSION Dynamic response of a viscoelastic Timoshenko beam [NASA-CR-181422] p 131 N87-29591 Composite space antenna structures - Properties and [AIAA PAPER 87-0890] TETHERLINES p 16 A87-33708 environmental effects p 20 A87-38610 TIN OXIDES Hollow cathode-based plasma contactor experiments for Measuring thermal expansion in large composite An electrically conductive thermal control surface for electrodynamic tether
[AIAA PAPER 87-0572] structures --- for spaceborne telescopes spacecraft encountering Low-Earth Orbit (LEO) atomic oxygen indium tin oxide-coated thermal blankets p 121 A87-32192 p 20 A87-38612 Preliminary results of CHARGE-2 tethered payload Taylored laminates with null or arbitrary coefficient of ermal expansion p 107 A87-51794 p 45 N87-26192 experiment p 121 A87-32521 thermal expansion On the payload-tether technology providing the THERMAL PLASMAS Space Station gas-grain simulation facility - Application microgravity circumstances in the proximity of the Space Potential modulations on SCATHA (Spacecraft Charging to exobiology p 127 A87-53002 Station p 122 A87-32533 At High Altitude) spacecraft TORQUE Some approximations for the dynamics of spacecraft [AD-A176815] p 140 N87-21024 Proposed CMG momentum management scheme for THERMAL PROTECTION space station [AIAA PAPER 87-2528] [AIAA PAPER 87-0821] Development status of a two-phase thermal p 122 A87-33687 p 62 A87-50531 On the dynamical stability of the space 'monoral management system for large spacecraft **TORQUE MOTORS** p 148 A87-34047 [SAE PAPER 8618281 p 41 A87-32662 Study of actuator for large space manipulator arm Electrodynamic plasma motor/generator experiment
[AAS PAPER 86-210] n.89 A87-38560 Prototype thermal bus for manned Space Station p 89 A87-38569 p 12 A87-32545 [SAE PAPER 861825] Tether power supplies exploiting the characteristics of The effect of circumferential aerodynamic detuning on Design parameters and environmental considerations IAAS PAPER 86-227] coupled bending-torsion unstalled supersonic flutter [ASME PAPER 86-GT-100] p 166 A87-2 p 123 A87-38571 for a reusable aeroassisted orbital transfer vehicle Plasma motor/generator reference system designs for p 166 A87-25396 [AIAA PAPER 87-1505] p 160 A87-43031 TORSIONAL VIBRATION power and propulsion [AAS PAPER 86-229] An electrically conductive thermal control surface for Flexibility control of torsional vibrations of a large solar p 89 A87-38572 spacecraft encountering Low-Earth Orbit (LEO) atomic Tether system and controlled gravity [AAS PAPER 86-240] p n 12 A87,32442 oxygen indium tin oxide-coated thermal blankets Determination of the natural frequencies of the p 124 A87-38573 p 45 N87-26192 longitudinal and torsional vibrations of truss structures with Technology and applications - Convergence to a tether THERMAL SIMULATION attached rigid bodies p 152 A87-46121 Development of an emulation-simulation thermal control [AAS PAPER 86-244] Modeling and control of torsional vibrations in a flexible p 124 A87-38574 model for space station application structure Electrodynamic tether propulsion - Potential uses and p 60 A87-50033 INASA-CR-1810091 p 45 N87-26072 TOWED BODIES THERMAL STABILITY p 124 A87-40510 Optimal shuttle altitude changes using tethers
[AD-A179205] p 129 N8 The radiation impedance of an electrodynamic tether Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794 with end connectors p 129 N87-22756 p 125 A87-42585 A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module **TOXIC HAZARDS** Space stable thermal control coatings Proposed application of automated biomonitoring for rapid detection of toxic substances in water supplies for [AD-A1827961 p 110 N87-28584 p 125 A87-43354 THERMAL STRESSES permanent space stations p 164 A87-40098 Investigation of plasma contactors for use with orbiting Radiation heat transfer calculations for space TRACE CONTAMINANTS structures Effects of varying environmental parameters on trace [NASA-CR-180922] p 129 N87-22509 [AIAA PAPER 87-1522] contaminant concentrations in the NASA Space Station Optimal shuttle altitude changes using tethers Evaluation of the built-in stresses and residual distortions Reference Configuration [AD-A179205] p 129 N87-22756 on cured composites for space antenna reflectors [SAE PAPER 860916] Thermal and dynamical effects on electrodynamic space p 47 A87-38708 applications p 22 A87-47327 A simulation model for the analysis of Space Station Dynamic and thermal effects in very large space ructures p 25 N87-20347 tethers [AD-A180276] gas-phase trace contaminants p 52 A87-53979 p 130 N87-25351 TRACKING (POSITION) Phase 3 study of selected tether applications in space. THERMAL VACUUM TESTS Solar array flight dynamic experiment [AAS PAPER 86-050] Volume 1: Executive summary Infrared test technique validation on the Olympus p 75 A87-32747 [NASA-CR-179185] p 131 N87-29585 satellite TRACKING NETWORKS Investigation of plasma contactors for use with orbiting [SAE PAPER 8609391 p 150 A87-38728 Japanese data relay satellite system THERMODYNAMIC CYCLES [AIAA PAPER 87-2199] [NASA-CR-181422] p 154 A87-48585 A transient analysis of phase change energy storage system for solar dynamic power p 131 N87-29591 TRACTION **TETRAHEDRONS** Traction-drive telerobot for space manipulation Near-field testing of the 5-meter model of the tetrahedral AIAA PAPER 87-1469] p 77 A87-43004 [DE87-005326] p 102 N87-22233 truss antenna THERMOELECTRIC GENERATORS Traction-drive, seven-degree-of-freedom telerobot arm: [NASA-CR-178147] Speculations on future opportunities to evolve Brayton D 30 N87-21987 A concept for manipulaton in space p 104 N87-29867 THERAPY owerplants aboard the space station TRADEOFFS Hyperbaric oxygen therapy for decompression accidents INASA-TM-898631 p 121 N87-23674 Potential applications to Space Station Operation
[SAE PAPER 860927] p 163 A87-Space Station EVA systems trade-off model THERMOELECTRICITY [SAE PAPER 860990] p 134 A87-38767 On the control of structures by applied thermal p 163 A87-38717 TRAINING ANALYSIS p 33 N87-22747 The undersea habitat as a space station analog: Thermal verification method for large sized spacecraft THERMOSPHERE Evaluation of research and training potential [NASA-CR-180342] p 53 Upper and Middle Atmospheric Density Modeling p 144 A87-32368 Thermal design of the ACCESS erectable space truss p 42 A87-34469 p 53 N87-27405 Requirements for Spacecraft Design and Operations [NASA-CP-2460] TRAJECTORIES p 64 N87-20665 Computer modeling of high-voltage solar array experiment using the NASCAP/LEO (NASA Charging Quality monitoring in two-phase heat transport systems THRUST CHAMBERS for large spacecraft [SAE PAPER 860959] Proven, long-life hydrogen/oxygen thrust chambers for Analyzer Program/Low Earth Orbit) computer code p 42 A87-38743 space station propulsion

p 98 N87-26133

[AD-A182589]

p 81 N87-28186

## **TRAJECTORY ANALYSIS**

TRAJECTORY ANALYSIS	TRUSSES	TUBES
Payload boomerang technology for space experiments	Deployable surface truss concepts and two-dimensional	Composite tubes for the Space Station truss structure p 20 A87-38601
at very low gravity level p 146 A87-32540	adaptive structures p 144 A87-32341	Microcrack resistant structural composite tubes for
TRAJECTORY OPTIMIZATION	Development of graphite epoxy space structure p 105 A87-32342	space applications p 106 A87-41022
Optimal trajectories for aeroassisted, coplanar orbital	Structure and function of Deployable Truss Beam	TUNING
transfer p 54 A87-31681		The effect of circumferential aerodynamic detuning on
Inadequacy of single-impulse transfers for path constrained rendezyous p 90 A87-41615	(DTB) p 12 A87-32546 An equivalent continuum analysis procedure for Space	coupled bending-torsion unstalled supersonic flutter
constrained rendezvous p 90 A87-41615 Combining space-based propulsive maneuvers and	Station lattice structures	[ASME PAPER 86-GT-100] p 166 A87-25396
aerodynamic maneuvers to achieve optimal orbital	[AIAA PAPER 87-0724] p 13 A87-33564	TURBOGENERATORS
transfer	New concepts of deployable truss units for large space	Organic Rankine cycle power conversion systems for space applications p 159 N87-28989
[AIAA PAPER 87-2567] p 93 A87-49617	structures	space applications p 159 N87-28989 TWO DIMENSIONAL BODIES
Optimal heading change with minimum energy loss for	[AIAA PAPER 87-0868] p 14 A87-33632	Deployable surface truss concepts and two-dimensional
a hypersonic gliding vehicle	Design considerations for a one-kilometer antenna	adaptive structures p 144 A87-32341
[AIAA PAPER 87-2568] p 136 A87-49618	stick [AIAA PAPER 87-0871] p 15 A87-33635	The design and development of a two-dimensional
TRANSFER FUNCTIONS	[AIAA PAPER 87-0871] p 15 A87-33635 Adaptive planar truss structures and their vibration	adaptive truss structure p 40 N87-29860
Lanczos modes for reduced-order control of flexible structures p 33 N87-22739	characteristics	TWO PHASE FLOW
structures p 33 N87-22/39 TRANSFER ORBITS	[AIAA PAPER 87-0743] p 148 A87-33667	Quality monitoring in two-phase heat transport systems
Optimal trajectories for aeroassisted, coplanar orbital	System identification of a truss type space structure	for large spacecraft
transfer p 54 A87-31681	using the multiple boundary condition test (MBCT)	[SAE PAPER 860959] p 42 A87-38743
A UK large diameter ion thruster for primary	method	Thermal test results of the two-phase thermal bus technology demonstration loop
propulsion	[AIAA PAPER 87-0746] p 16 A87-33670	[AIAA PAPER 87-1627] p 44 A87-43125
[AIAA PAPER 87-1031] p 89 A87-38015	Effects of local vibrations on the dynamics of space	Microgravity fluid management in two-phase thermal
Inadequacy of single-impulse transfers for path	truss structures [AIAA PAPER 87-0941] p 17 A87-33739	systems p 95 N87-21152
constrained rendezvous p 90 A87-41615	[AIAA PAPER 87-0941] p 17 A87-33739 Wave propagation in periodic truss structures	Two-phase reduced gravity experiments for a space
Optical correlator use at Johnson Space Center p 59 A87-42655	[AIAA PAPER 87-0944] p 18 A87-33742	reactor design p 8 N87-21154
NERVA derived nuclear orbit transfer system	Alternative methods to fold/deploy tetrahedral or	
[AIAA PAPER 87-2155] p 92 A87-45439	pentahedral truss platforms p 19 A87-34467	U
Combining space-based propulsive maneuvers and	Thermal design of the ACCESS erectable space truss	•
aerodynamic maneuvers to achieve optimal orbital	p 42 A87-34469	U.S.S.R.
transfer	Reduced modeling and analysis of large repetitive space	Status of orbital astronomy projects
[AIAA PAPER 87-2567] p 93 A87-49617	structures via continuum/discrete concepts	p 128 N87-21973
TRANSIENT LOADS	p 19 A87-35327	U.S.S.R. SPACE PROGRAM
Influence co-efficient testing as a substitute for modal	A hybrid nonlinear programming method for design optimization p 7 A87-35718	Contribution of the German Democratic Republic (East
survey testing of large space structures p 27 N87-20369	optimization p / A87-35/18 Composite tubes for the Space Station truss structure	Germany) to the 'Intercosmos' program of study of
TRANSIENT RESPONSE	p 20 A87-38601	materials in space aboard the orbiting station Salyut 6 p 147 A87-32814
Control augmented structural synthesis with transient	Incorporation of the effects of material damping and	Manned space flight comparisons between U.S. and
response constraints	nonlinearities on the dynamics of space structures	U.S.S.R. programs p 167 A87-33019
[AIAA PAPER 87-0749] p 56 A87-33573	p 21 A87-40075	International cooperation in space
Nonlinear transient analysis of joint dominated	Determination of the natural frequencies of the	p 149 A87-34594
structures	longitudinal and torsional vibrations of truss structures with	Advances by the Soviet Union in space cooperation and
[AIAA PAPER 87-0892] p 17 A87-33709	attached rigid bodies p 152 A87-46121  Development of full scale deployable CFRP truss for	commercial marketing made 1986 a landmark year
An experimental study of transient waves in a plane		p 149 A87-34595
grid structure [AIAA PAPER 87-0943] p 18 A87-33741	space structure p 25 A87-51793  Modeling of joints for the dynamic analysis of truss	The Gagarin scientific lectures in astronautics and aviation, 1985 Russian book p 152 A87-42923
[AIAA PAPER 87-0943] p 18 A87-33741 Modeling of environmentally induced transients within	structures	
satellites	[NASA-TP-2661] p 28 N87-20567	Mir - A second Sputnik? p 153 A87-468/2 The Soviet space shuttle programme
[AIAA PAPER 85-0387] p 7 A87-41611	Near-field testing of the 5-meter model of the tetrahedral	p 153 A87-47302
A formulation for studying steady state/transient	truss antenna	The GDR and the Soviet space program - The optical
dynamics of a large class of spacecraft and its	[NASA-CR-178147] p 30 N87-21987	instrument sector of the GDR contributions
application p 35 N87-25357	Dynamics of trusses having nonlinear joints	p 155 A87-53559
Response of joint dominated space structures	p 32 N87-22724	Space biology and medicine on the twenty-fifth
[NASA-CR-180564] p 36 N87-26071	Equivalent beam modeling using numerical reduction techniques p 32 N87-22725	anniversary of the first spaceflight of Yuriy Alekseyevich
Response of joint dominated space structures (NASA-CR-181202) p 37 N87-26397	techniques p 32 N87-22725  Dual keel space station control/structures interaction	Gagarin p 157 N87-20732
[NASA-CR-181202] p 37 NB7-26397 TRANSLATIONAL MOTION	study p 67 N87-22737	UK SPACE PROGRAM  British activities in space p 143 A87-32280
Dynamics of a multibody system with relative translation	Experimental characterization of deployable trusses and	British activities in space p 143 A87-32280  A UK large diameter ion thruster for primary
on curved, flexible tracks p 58 A87-40867	joints p 33 N87-22749	propulsion
TRANSMISSION LINES	Box truss antenna technology status	[AIAA PAPER 87-1031] p 89 A87-38015
Coaxial tube array space transmission line	p 87 N87-24503	Columbus/Space Station United Kingdom Utilisation
characterization	Hoop/column and tetrahedral truss electromagnetic tests p 87 N87-24504	Study 1985/6 Report - Executive Summary
[NASA-TM-89864] p 96 N87-22003	tests p 87 N87-24504 Application of physical parameter identification to	p 151 A87-41429
TRANSMITTER RECEIVERS  The effect of multipath on digital communications	finite-element models p 34 N87-24505	A polar platform for the remote sensing needs of ecology
systems: With application to space station	Design, development and fabrication of a	and agriculture - A view from the U.K.
[AD-A178578] p 86 N87-22876	deployable/retractable truss beam model for large space	Space Station opportunity for UK in earth sensing
Fiber optics wavelength division	structures application	p 152 A87-41678
multiplexing(components) p 117 N87-29151	[NASA-CR-178287] p 35 N87-25349	Ion thrusters advance p 93 A87-54196
Fiber optics common transceiver module	Deployable geodesic truss structure  FNASA-CASF-LAR-13113-11 p 36 N87-25492	ULLAGE
p 117 N87-29160		Mixing-induced fluid destratification and ullage
TRANSPARENCE	Collect lock joint for space station truss [NASA-CASE-MSC-21207-1] p 36 N87-25576	condensation p 95 N87-21149
Aromatic polyester polysiloxane block copolymers:	Experimental evaluation of small-scale erectable truss	ULTRAHIGH FREQUENCIES On-board K- and S-band multi-beam antennas
Multiphase transparent damping materials [AD-A182623] p 110 N87-27809	hardware	p 86 A87-46281
(,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	[NASA-TM-89068] p 37 N87-26085	UNDERWATER RESEARCH LABORATORIES
TRANSPORTER  The design and development of a mobile transporter	Joint nonlinearity effects in the design of a flexible truss	The undersea habitat as a space station analog:
system for the Space Station Remote Manipulator	structure control system	Evaluation of research and training potential
System p 104 N87-29865	[NASA-CR-180633] p 37 N87-26365	[NASA-CR-180342] p 53 N87-27405
TRAVELING WAVES	Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures	UNIONS (CONNECTORS)
Localization in disordered periodic structures	spacecraft masts	Preloaded space structural coupling joints [NASA-CASE-LAR-13489-1] p 38 N87-27713
[AlAA PAPER 87-0819] p 19 A87-33757	[NASA-CR-180317] p 38 N87-27260	
Some problems in the control of large space	Remote handling facility and equipment used for space	UNMANNED SPACECRAFT Mir in action p 150 A87-37971
structures	truss assembly	We shouldn't build the Space Station now
[AD-A179989] p 70 N87-25350	[DE87-009121] p 103 N87-27408	p 169 A87-46875
Active vibration damping of flexible structures using the	Preloaded space structural coupling joints	UPPER STAGE ROCKET ENGINES
traveling wave approach p 71 N87-25360	[NASA-CASE-LAR-13489-1] p 38 N87-27713 Folding, articulated, square truss p 40 N87-29859	Space launcher upper stages - Design for mission
TREATMENT	Folding, articulated, square truss p 40 N87-29859  The design and development of a two-dimensional	versatility and/or orbital operation p 132 A87-32474
When the doctor is 200 miles away	adaptive truss structure p 40 N87-29860	URINE
TRIBOLOGY	The design and development of a mobile transporter	Development of a water recovery subsystem based on
Development of harmonic drive actuator for space	system for the Space Station Remote Manipulator	Vapor Phase Catalytic Ammonia Removal (VPCAR)
manipulator p 149 A87-35076	System p 104 N87-29865	[SAE PAPER 860985] p 50 A87-38764

p 33 N87-22747

n 34 N87-23980

SUBJECT INDEX		
USER REQUIREMENTS Commercial US transfer vehicle	overviev	•
[SAE PAPER 861764]	P	
User interface design guidentroubleshooting systems for Spa	delines	for expe
troubleshooting systems for Spa	ice Stati p	
Japanese customer needs for Sp		
[AIAA PAPER 87-2193]	p 15	
Scientific user requirements for (European aspects)	microgr	avity researc
[AIAA PAPER 87-2195]	p 15	3 A87-4858
Scientific customer needs - NAS, [AIAA PAPER 87-2196]		0 407 4050
Standards for the user interface	p 11: Deve	9 A87-4858:
consensus for Space Station Infe	ormation	n System
[AIAA PAPER 87-2209]	p 16	9 A87-4859
Advanced EVA system design EVAS/space station system interfa	n requiri ce reaui	ements study rements
[NASA-CR-171981]	p 120	N87-2035
European utilization aspects stud		
UTILIZATION	ртос	N87-2062
Columbus/Space Station United	Kingdo	m Utilisation
Study 1985/6 Report - Executive S		A87-41429
	p 15	A01-41423
V		
•		
VACUUM TESTS		
Study of actuator for large space		ator arm ! A87-32545
VAPOR PHASES		
Phase change water recovery Parametric testing and analysis	for Sp	ace Station -
[SAE PAPER 860986]	p 51	A87-38765
/APORIZING		
Production of pulsed atomic oxyl vaporization methods	gen bea p 106	
/APORS	p 100	A07-30023
Mixing-induced fluid destratific		and ullage
condensation /ARIABILITY	p 95	N87-21149
A method of variable spacing for co	ontrolled	plant growth
systems in spaceflight and te	errestrial	agriculture
applications [NASA-CR-177447]	p 130	N87-25767
ARIABLE GEOMETRY STRUCTURE	S	
Adaptive planar truss structures characteristics	and the	eir vibration
[AIAA PAPER 87-0743]	p 148	A87-33667
Problems of mechanical system co	onfigurat	tion control
ECTOR CURRENTS	p 149	A87-35877
Preloadable vector sensitive latch		
[NASA-CASE-MSC-20910-1]	p 161	N87-25582
Space-based OTV boiloff disposition	on	
[AIAA PAPER 87-1767]	p 91	A87-45191
ERSATILITY 20 kHz Space Station power syste	m	
	 p 76	A87-40378
HSIC (CIRCUITS) A VHSIC general purpose procession	~	
	р 116	N87-29145
IBRATION The Shock and Vibration Bulletin	. Doet 1	I. Walasa
The Shock and Vibration Bulletin Invited Papers, Shipboard Shock, Blas	1. Part⊺ tandGr	ound Shock
Shock Testing and Analysis		
[AD-A175224] Guidelines for noise and vibration	p 29 Iovole fo	N87-20574
station	revels IC	л ине врасе
[NASA-CR-178310]	p 120	N87-24162
IBRATION DAMPING A consideration to vibration control	ol for a	larna enann
structures		A87-32441

An identification method for flexible structures

structures

[AAS PAPER 86-004]

[AIAA PAPER 87-0741]

[AIAA PAPER 87-0745]

control

p 16 A87-33669

SER REQUIREMENTS	Experience in distributed parameter modeling of t
Commercial US transfer vehicle overview [SAE PAPER 861764] p 1 A87-32625	Spacecraft Control Laboratory Experiment (SCOL
User interface design guidelines for expert	structure [AIAA PAPER 87-0895] p 16 A87-336
troubleshooting systems for Space Station	On the control of flexible structures by applied them
p 6 A87-33050 Japanese customer needs for Space Station	gradients [AIAA PAPER 87-0887] p 16 A87-337
[AIAA PAPER 87-2193] p 153 A87-48580	Positive position feedback control for large spa
Scientific user requirements for microgravity research	structures
(European aspects)	[AIAA PAPER 87-0902] p 17 A87-337 A comparison of active vibration control techniques
Scientific customer needs - NASA user	Output feedback vs optimal control
[AIAA PAPER 87-2196] p 119 A87-48582	[AIAA PAPER 87-0904] p 56 A87-337
Standards for the user interface - Developing a user	Accuracy of derivatives of control performance using reduced structural model
consensus for Space Station Information System [AIAA PAPER 87-2209] p 169 A87-48594	[AIAA PAPER 87-0905] p 57 A87-337
Advanced EVA system design requirements study:	Structural and control optimization of space structural [AIAA PAPER 87-0939] p 17 A87-337:
EVAS/space station system interface requirements [NASA-CR-171981] p 120 N87-20351	On a balanced passive damping and active vibration
[NASA-CR-171981] p 120 N87-20351 European utilization aspects studies space stations	suppression of large space structures [AIAA PAPER 87-0901] p 19 A87-3470
p 156 N87-20624	[AIAA PAPEH 87-0901] p 19 A87-3470 Control of flexible structures by applied therm
TILIZATION	gradients p 21 A87-3954
Columbus/Space Station United Kingdom Utilisation Study 1985/6 Report - Executive Summary	The design and analysis of passive damping f aerospace systems
p 151 A87-41429	[AIAA PAPER 87-0891] p 58 A87-3964
	Gradient-based combined structural and controptimization p.21 A87-4096
V	optimization p 21 A87-4086 Modeling, stabilization and control of serially connecte
	beams p 21 A87-4105
ACUUM TESTS Study of actuator for large space manipulator arm	Perturbation analysis of internal balancing for light damped mechanical systems with gyroscopic ar
p 12 A87-32545	circulatory forces p 22 A87-4781
APOR PHASES	Material damping in aluminum and metal matr
Phase change water recovery for Space Station - Parametric testing and analysis	composites p 106 A87-4979  Low-authority control of large space structures by usin
[SAE PAPER 860986] p 51 A87-38765	tendon control system
PORIZING	[AIAA PAPER 87-2249] p 60 A87-5041 Control of distributed structures with small
Production of pulsed atomic oxygen beams via laser vaporization methods p 106 A87-38625	Control of distributed structures with sma nonproportional damping
PORS	[AIAA PAPER 87-2250] p 60 A87-5041
Mixing-induced fluid destratification and ullage	The control of linear dampers for large spac structures
condensation p 95 N87-21149  IRIABILITY	[AIAA PAPER 87-2251] p 60 A87-5041
A method of variable spacing for controlled plant growth	Active damping control design for the COFS Mast Fligh
systems in spaceflight and terrestrial agriculture	System Control of Flexible Structures program for NASA
applications NASA-CR-177447] p 130 N87-25767	[AIAA PAPER 87-2321] p 23 A87-5044
NASA-CH-177447] p 130 N87-25767 RIABLE GEOMETRY STRUCTURES	Active vibration control synthesis for the COFS-I - / classical approach Control of Flexible Structure
Adaptive planar truss structures and their vibration	experiment for NASA
characteristics AIAA PAPER 87-0743] p 148 A87-33667	[AIAA PAPER 87-2322] p 23 A87-5044
Problems of mechanical system configuration control	Suboptimal feedback vibration control of a beam wit a proof-mass actuator large space structures
p 149 A87-35877	[AIAA PAPER 87-2323] p 23 A87-5044
CTOR CURRENTS Preloadable vector sensitive latch	A new concept of generalized structural filtering to active vibration control synthesis
NASA-CASE-MSC-20910-1] p 161 N87-25582	[AIAA PAPER 87-2456] p 24 A87-50502
NTING Space-based OTV boiloff disposition	Tracking and pointing maneuvers with slew-excited
AIAA PAPER 87-1767] p 91 A87-45191	deformation shaping [AIAA PAPER 87-2599] p 62 A87-50561
RSATILITY	Effect of modal damping in modal synthesis of spacecraft
20 kHz Space Station power system p 76 A87-40378	structures p 26 N87-20362
SIC (CIRCUITS)	Modal-survey testing for system identification and dynamic qualification of spacecraft structures
A VHSIC general purpose processor	p 27 N87-20365
P 116 N87-29145	Benefits of passive damping as applied to active contro of large space structures p 63 N87-20371
The Shock and Vibration Bulletin. Part 1: Welcome,	Modeling and control of flexible structures
rvited Papers, Shipboard Shock, Blast and Ground Shock, hock Testing and Analysis	p 28 N87-20564 Initial investigations into the damping characteristics of
AD-A175224] p 29 N87-20574	wire rope vibration isolators
Guidelines for noise and vibration levels for the space tation	[NASA-CR-180698] p 28 N87-20569
NASA-CR-178310] p 120 N87-24162	Modeling and control of flexible structures [AD-A177106] p 29 N87-21388
RATION DAMPING	Optimum mix of passive and active control of space
A consideration to vibration control for a large space tructures p 54 A87-32441	structures p 65 N87-22714 Status report and preliminary results of the spacecraft
Flexibility control of torsional vibrations of a large solar	control laboratory experiment p 66 N87-22717
Tay p 12 A87-32442	Dynamics of trusses having nonlinear joints
Vibration control for a linked system of flexible ructures p 55 A87-32444	p 32 N87-22724 Workshop on Structural Dynamics and Control
A preliminary study on a linear inertial actuator for LSS	Interaction of Flexible Structures p 32 N87-22728
ontrol p 55 A87-32447 Control of flexible solar arrays with consideration of the	Vibration suppression by stiffness control
ctuator dynamics of the reaction wheel	p 66 N87-22730 Impact of space station appendage vibrations on the
p 55 A87-32448	pointing performance of gimballed payloads
Control of a flexible space manipulator p 99 A87-32449	p 32 N87-22733
Low-authority control through passive damping	spacecraft p 67 N87-22734
AS PAPER 86-004] p 55 A87-32730	Slewing control experiment for a flexible panel
Vibration suppression using a constrained rate-feedback ireshold control strategy for large space structures	p 78 N87-22740 A new approach for vibration control in large space
IAA PAPER 87-0741] p 6 A87-33665	structures p 33 N87-22743

```
xperience in distributed parameter modeling of the
                                                              On the control of structures by applied thermal
acecraft Control Laboratory Experiment (SCOLE)
                                                            gradients
                                                             Analytical determination of space station response to
A PAPER 87-08951
                                  p 16 A87-33689
                                                           crew motion and design of suspension system for microgravity experiments p 67 N87-22752
n the control of flexible structures by applied thermal
lionto
                                                             Modified independent modal space control method for
A PAPER 87-08871
                                  p 16 A87-33706
                                                            active control of flexible systems
ositive position feedback control for large space
                                                           [NASA-CR-181065]
cturae
                                                             NASA/DOD Control/Structures Interaction Technology,
A PAPER 87-09021
                                  p 17 A87-33711
                                                            1986
comparison of active vibration control techniques -
out feedback vs optimal control
A PAPER 87-09041
                                  p 56 A87-33713
ccuracy of derivatives of control performance using a
ced structural model
A PAPER 87-09051
                                  p 57 A87-33714
tructural and control optimization of space structures
A PAPER 87-0939]
                                 p 17
                                       A87-33737
n a balanced passive damping and active vibration
pression of large space structures
A PAPER 87-0901]
                                 p 19 A87-34701
ontrol of flexible structures by applied thermal
                                 D 21 A87-39543
ne design and analysis of passive damping for
space systems
A PAPER 87-08911
                                  p.58 A87-39644
radient-based combined structural and control nization p 21 A87-40866
odeling, stabilization and control of serially connected ns p 21 A87-41052
erturbation analysis of internal balancing for lightly
ped mechanical systems with gyroscopic and
latory forces
                                 D 22 A87-47812
aterial damping in aluminum and metal matrix posites p 106 A87-49797
w-authority control of large space structures by using
                                                          structures
on control system
A PAPER 87-22491
                                 p 60 A87-50413
introl of distributed structures with small
roportional damping
A PAPER 87-2250]
                                 p 60 A87-50414
e control of linear dampers
                                for large space
A PAPER 87-2251]
tive damping control design for the COFS Mast Flight
em --- Control of Flexible Structures program for
A PAPER 87-2321]
tive vibration control synthesis for the COFS-I - A
ical approach --- Control of Flexible Structures
ment for NASA
PAPER 87-23221
                                p 23 A87-50443
optimal feedback vibration control of a beam with
of-mass actuator --- large space structures
PAPER 87-2323]
                                p 23 A87-50444
                                                          feedback
new concept of generalized structural filtering for
vibration control synthesis
PAPER 87-2456]
                                p 24 A87-50502
cking and pointing maneuvers with slew-excited
nation shaping
 PAPER 87-25991
                                p 62 A87-50561
ct of modal damping in modal synthesis of spacecraft
dal-survey testing for system identification and
nic qualification of spacecraft structures
                                p 27 N87-20365
efits of passive damping as applied to active control
e space structures
                               p 63 N87-20371
deling and control of flexible structures
                               p 28 N87-20564
al investigations into the damping characteristics of
ope vibration isolators
-CR-180698]
                               p 28 N87-20569
leling and control of flexible structures
                               p 29 N87-21388
mum mix of passive and active control of space
ires
                               p 65 N87-22714
us report and preliminary results of the spacecraft
laboratory experiment
                               p 66 N87-22717
amics of trusses having nonlinear joints
                               p 32 N87-22724
        on Structural Dynamics and Control
tion of Flexible Structures
                              p 32 N87-22728
ation suppression by stiffness control
                               p 66 N87-22730
act of space station appendage vibrations on the
```

p 165 N87-22744

Crew activity and motion effects on the space station

[NASA-CP-2447-PT-2] p 34 N87-24495 Joint Optics Structures Experiment (JOSE) p 34 N87-24497 Application of physical parameter identification to p 34 N87-24505 Structural control by the use of piezoelectric active p 69 N87-24509 Research in slewing and tracking control p 70 N87-24512 Evaluation of on-line pulse control for vibration suppression in flexible spacecraft [NASA-CR-180391] p 70 N87-24513 Investigation for damping design and related nonlinear ribrations of spacecraft structures [EMSB-64/85] p 35 N87-24516 Spectral factorization and homogenization methods for modeling and control of flexible structures [AD-A1797261 p 35 N87-24517 Distributed control using linear momentum exchange [NASA-TM-100308] p 70 N87-24521 Characterization and hardware modification of linear momentum exchange devices [NASA-TM-865941 p 70 N87-24723 Some problems in the control of large space [AD-A179989] p 70 N87-25350 Active vibration damping of flexible structures using the p 71 traveling wave approach A comparison between IMSC, PI and MIMSC methods controlling the vibration of flexible systems [NASA-CR-181156] p 36 N87-25605 Development of intelligent structures using finite control ements in a hierarchic and distributed control system [AD-A179711] p 72 N87-25805 Vibration control of flexible structures using piezoelectric devices as sensors and actuators p 37 N87-26387 Active vibration control in microgravity environment p 72 N87-26700 Study on investigation of the attitude control of large flexible spacecraft. Phase 1, volume 1: Technical report [ESA-CR(P)-2361-VOL-1] p 73 N87-27706 p 73 N87-27706 An experimental investigation of vibration suppression large space structures using positive position p 39 N87-28937 Effect of bonding on the performance of a piezoactuator-based active control system [NASA-CR-1814141 p 74 N87-29713 VIBRATION ISOLATORS Initial investigations into the damping characteristics of wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728 Vibration isolation for line of sight performance provement p 67 N87-22742 improvement Crew activity and motion effects on the space station p 165 N87-22744 Analytical determination of space station response to crew motion and design of suspension system for microgravity experiments p 67 N87-22752 Theory and application of linear servo dampers for large ale space structures p 72 N87-26970 Aromatic polyester polysiloxane block copolymers: Multiphase transparent damping materials [AD-A182623] p 110 N87-27809 A microgravity isolation mount p 161 N87-29861 VIBRATION MODE Space structure vibration modes - How many exist? Which ones are important? p 11 A87-32120 Optimization procedure to control the coupling of vibration modes in flexible space structures [AIAA PAPER 87-0826] p 14 A87-33613 Spillover stabilization and decentralized modal control of large space structures [AIAA PAPER 87-0903] p 17 A87-33712 Effects of local vibrations on the dynamics of space [AIAA PAPER 87-0941] p 17 A87-33739 An experimental study of transient waves in a plane arid structure [AIAA PAPER 87-0943] p 18 A87-33741 Dynamic analysis and experiment methods for a generic space station model p 22 A87-41613 Modal-survey testing of the Olympus spacecraft p 152 A87-42266

Wave-mode coordinates and scattering matrices for

### **VIBRATION TESTS**

VIDITATION	
Dynamics of gyroelastic spacecraft p 59 A87-47811	WASTE TREATMENT
Effect of modal damping in modal synthesis of spacecraft	Development of a water recovery subsystem based on
structures p 26 N87-20362	Vapor Phase Catalytic Ammonia Removal (VPCAR) [SAE PAPER 860985] p 50 A87-38764
Space Station/Shuttle Orbiter dynamics during p 65 N87-22708	Integrated waste and water management system
Dynamic characteristics of a vibrating beam with periodic	[SAE PAPER 860996] p 51 A87-38773
variation in bending stiffness p 32 N87-22726	CELSS waste management systems evaluation
VIRRATION TESTS	[SAE PAPER 860997] p 51 A87-38774
On sine dwell or broadband methods for modal testing	Electrochemical processing of solid waste [NASA-CR-181128] p 137 N87-25443
[AIAA PAPER 87-0961] p 18 A87-33752	[NASA-CR-181128] p 137 N87-25443 WASTE UTILIZATION
A modern approach for modal testing using multiple input sine excitation	Hydrogen/oxygen economy for the space station
[AIAA PAPER 87-0964] p 19 A87-33754	p 98 N87-26130
Dynamic analysis and experiment methods for a generic	WASTE WATER
space station model p 22 A87-41613	Water recycling for Space Station p 46 A87-32459
Modal-survey testing of the Olympus spacecraft	Pre- and post-treatment techniques for spacecraft water
p 152 A87-42266	recovery [SAE PAPER 860982] p 50 A87-38761
Low frequency vibration testing on satellites p 27 N87-20364	Results on reuse of reclaimed shower water
Spacecraft qualification using advanced vibration and	[SAF PAPER 860983] p 50 A87-38762
modal testing techniques p 27 N87-20368	A membrane-based subsystem for very high recoveries
Multi-axis vibration tests on spacecraft using hydraulic	of spacecraft waste waters
exciters p 8 N87-20373	[SAE PAPER 860984] p 50 A87-38763 Phase change water recovery for Space Station -
VIBRATIONAL SPECTRA	Parametric testing and analysis
Modeling and control of flexible structures [AD-A177106] p 29 N87-21388	read DADER 8609861 p.51 A87-38765
VIDEO DATA	Supercritical water oxidation - Concept analysis for
Video image processing p 116 N87-29150	evolutionary Space Station application
VIDEO FOUIPMENT	[SAE PAPER 860993] p 51 A87-38770
tice of a video-photogrammetry system for the	WATER Gas and water recycling system for IOC vivarium
measurement of the dynamic response of the shuttle	experiments Initial Operational Capacity
Tellioto manipalate. a	p 46 A87-32457
VIDEO SIGNALS	Hydrogen/oxygen economy for the space station
Use of a video-photogrammetry system for the	p 98 N87-26130
measurement of the dynamic response of the shuttle	Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135
remote manipulator arm p 101 N87-20370	[14/10/1 1tm reality]
VISCOELASTIC DAMPING	WATER MANAGEMENT Integrated waste and water management system
Dynamic response of a viscoelastic Timoshenko beam	[SAF PAPER 860996] p 51 A87-38773
VISCOEI ASTICITY	The impact of integrated water management on the
Modeling and computational algorithms for parameter	Space Station propulsion system
estimation and optimal control of aeroelastic systems and	[AIAA PAPER 87-1864] p 91 A87-45259
large flexible structures	WATER QUALITY Proposed application of automated biomonitoring for
[AD-A183302] p 11 N87-29893	rapid detection of toxic substances in water supplies for
VISCOUS DAMPING  Variable structure controller design for spacecraft	permanent space stations p 164 A87-40098
nutation damping p 58 A87-39958	Quality requirements for reclaimed/recycled water
Incorporation of the effects of material damping and	[NASA-TM-58279] p 53 N87-2/392
pontinearities on the dynamics of space structures	WATER RECLAMATION
p 21 A87-400/5	Water recycling system using thermopervaporation p 46 A87-32458
Response bounds for linear underdamped systems [ASME PAPER 87-APM-34] p 59 A87-42505	Water recycling for Space Station p 46 A87-32459
[ASME PAPER 87-APM-34] p 59 A87-42505 Dynamic qualification of spacecraft by means of modal	Pre- and post-treatment techniques for spacecraft water
eynthesis p 26 NB7-20363	recovery
Renefits of passive damping as applied to active control	[SAE PAPER 860982] p 50 A87-38761
of large space structures p 63 N87-20371	Results on reuse of reclaimed shower water [SAF PAPER 860983] p 50 A87-38762
VOICE CONTROL	[SAE PAPER 860983] p 50 A87-38762 A membrane-based subsystem for very high recoveries
Use of heads-up displays, speech recognition, and	of spacecraft waste waters
speech synthesis in controlling a remotely piloted space	[SAF PAPER 860984] p 50 A87-38763
vehicle p 99 A67-31493	Phase change water recovery for Space Station -
\A/	Parametric testing and analysis
AA.	[SAF PAPER 860986] p 51 A87-38765
WAKEC	Air Evaporation closed cycle water recovery technology
WAKES Spacecraft charging in the auroral plasma: Progress	- Advanced energy saving designs [SAE PAPER 860987] p 51 A87-38766
toward understanding the physical effects involved	The impact of integrated water management on the
p 142 N87-26949	Space Station propulsion system
Documentation for the SHADO particle wake routine	[AIAA PAPER 87-1864] p 91 A87-45259
[AD-A181531] p 131 N87-26967	Quality requirements for reclaimed/recycled water (NASA-TM-58279) p 53 N87-27392
WALLS Space station integrated wall design and penetration	[NASA-TM-58279] p 53 N87-27392 WATER TREATMENT
damage control	Results on reuse of reclaimed shower water
[NASA_CR_179165] D 39 N87-28581	[SAF PAPER 860983] p 50 A87-38762
Space station integrated wall design and penetration	A membrane-based subsystem for very high recoveries
damage control. Task 3: Theoretical analysis of penetration	of spacecraft waste waters
mechanics (NASA-CR-179166) p 39 N87-28582	[SAE PAPER 860984] p 50 A87-38763 Phase change water recovery for Space Station -
[NASA-CR-179166] p 39 N87-28582 Space station integrated wall design and penetration	Parametric testing and analysis
damage control. Task 4: Impact detection/location	[SAE PAPER 860986] p 51 A87-38765
svstem	Air Evaporation closed cycle water recovery technology
[NASA_CR-179167] p.4 N87-28583	- Advanced energy saving designs
Vibrations and structureborne noise in space station	[SAE PAPER 860987] p 51 A87-38766
[NASA-CR-181381] p 39 N87-29590	Supercritical water oxidation - Concept analysis for
WARFARE	evolutionary Space Station application [SAF PAPER 860993] p 51 A87-38770
Present and future military uses of outer space: International law, politics, and the practice of states	[SAE PAPER 860993] p 51 A87-38770 WAVE ATTENUATION
[AD-A176722] p 170 N87-21753	Localization in disordered periodic structures
WARNING SYSTEMS	[AIAA PAPER 87-0819] p 19 A87-33757
Proposed application of automated biomonitoring for	WAVE PROPAGATION
rapid detection of toxic substances in water supplies for	An experimental study of transient waves in a plane
permanent space stations p 164 A87-40098 WASTE DISPOSAL	grid structure [AIAA PAPER 87-0943] p 18 A87-33741

```
wave propagation
[AD-A176998]
                                          p 29 N87-21030
   Comparison of wave-mode coordinate and pulse
  summation methods
                                          p 30 N87-21992
 [AD-A177795]
    Wave propagation in transversely isotropic continuum
  models of LSS (Large Space Structures)
                                          p 30 N87-22256
  (AD-A1772711
    Modeling of controlled flexible structures with impulsive
                                          p 33 N87-22745
WAVE SCATTERING
    Wave-mode coordinates and scattering matrices for
  wave propagation
[AD-A176998]
                                           p 29 N87-21030
WAVEGUIDE ANTENNAS
    Carbon fibre slotted waveguide arrays
                                          p 85 A87-41302
WEIGHT REDUCTION
  Structural optimization with frequency constraints [AIAA PAPER 87-0787] p 13 A87-
    AIAA PAPER 87-0787] p 13 A87-33588
Experience in distributed parameter modeling of the
  Spacecraft Control Laboratory Experiment (SCOLE)
  structure
                                           p 16 A87-33689
  [AIAA PAPER 87-0895]
  A basis change strategy for the reduced gradient method and the optimum design of large structures
                                          p 23 A87-48341
    Use of lightweight composites for GAS payload p 25 N87-20307
   structures
WEIGHTLESS FLUIDS
     Analytical and experimental modeling of zero/low gravity
   fluid behavior
                                           p 91 A87-45260
   [AIAA PAPER 87-1865]
   Mixing-induced ullage condensation and fluid destratification
   [AIAA PAPER 87-2018]
                                           p 92 A87-45357
  Liquid propellant tank ullage bubble deformation and breakup in low gravity reorientation
[AIAA PAPER 87-2021] p 92 A87-45360
 WEIGHTLESSNESS
      A question of gravity p 1 A87-32116 Identification of the zero-g shape of a space beam IAA PAPER 87-0872] p 15 A87-33636
   [AIAA PAPER 87-0872]
     Microgravity Fluid Management Symposium
                                           p 94 N87-21141
   [NASA-CP-2465]
 WEST GERMANY
     Highlights of the German Space Programme
                                           p 143 A87-32282
 WIND MEASUREMENT
     An advanced wind scatterometer for the Columbus Polar
                                           p 155 A87-53117
   Platform payload
                                           p 116 N87-29148
     Flight array processor
 WIRE
     Analytical solutions for static elastic deformations of wire
   [AIAA PAPER 87-0720]
                                              p 6 A87-33561
      Initial investigations into the damping characteristics of
   wire rope vibration isolators
[NASA-CR-180698]
                                            p 28 N87-20569
  WORKING FLUIDS
      Development of fluid loop system for spacecraft
                                           p 144 A87-32370
      Development of a prototype two-phase thermal bus
    system for Space Station
                                             p 44 A87-43126
  WORKLOADS (PSYCHOPHYSIOLOGY)
    Energy expenditure during simulated EVA workloads [SAE PAPER 860921] p 163 A87-38713
      Evaluation of physical work capacity of cosmonauts
```

The development of an EVA Universal Work Station SAL PAPER 860952] p 164 A87-38738 SOT: A rapid prototype using TAE windows

p 157 N87-20735

p 171 N87-25760

p 114 N87-23161 A workstation environment for software engineering p 116 N87-29128

Workshop on Workload and Training, and Examination

Electronic control/display interface technology p 88 N87-29161

aboard Salyut-6 station

[NASA-TM-89459] WORKSTATIONS

p 18 A87-33742

Wave propagation in periodic truss structures
[AIAA PAPER 87-0944] p 18 Ai

[SAE PAPER 860952]

of their Interactions: Executive summary

User interface and payload command and control p 73 N87-29162

X

X RAY ASTRONOMY Coded mask telescopes for X-ray astronomy p 123 A87-3778 'HEXE' - X-ray observatory in space

p 155 A87-53556

Status of orbital astronomy projects p 128 N87-21973

WASTE DISPOSAL

An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784

p 119 A87-38784

X RAY SOURCES
Mir in action p 150 A87-37971
X RAY TELESCOPES
Coded mask telescopes for X-ray astronomy
p 123 A87-37785



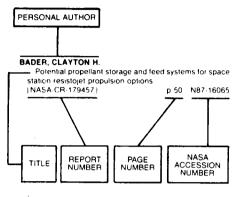
YOKES
Preloadable vector sensitive latch
[NASA-CASE-MSC-20910-1]

p 161 N87-25582

## SPACE STATION SYSTEMS / A Bibliography (Supplement 6)

JULY 1988

## Typical Personal Author Index Listing



Listings in this index are arranged alphabetically by personal author. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document listed (e.g. NASA report, translation, NASA contractor report). The page and accession numbers are located beheath and to the right of the title. Under any one author's name the accession numbers are arranged in sequence with the AIAA accession numbers appearing first

### **ABE. TOSHIO**

Laboratory simulation of plasma interaction with high voltage solar array p 145 A87-32388

## ABEL, JOSEPH E.

Satellite servicing logistics [SAE PAPER 861723]

p 132 A87-32612

## ABELES, FRED

The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739

### ABELES, FRED J.

Physiological aspects of EVA [SAE PAPER 860991]

p 164 A87-38768

## ABHYANKAR, NANDAKISHOR SADASHIV

Studies in nonlinear structural dynamics: Chaotic p 26 N87-20348 behavior and poynting effect ABROUS, A.

## Radiation heat transfer calculations for space

### [AIAA PAPER 87-1522] p 44 A87-44830

## ACRES, WILLIAM R.

Preloadable vector sensitive latch

[NASA-CASE-MSC-20910-1] p 161 N87-25582 The preloadable vector sensitive latch for orbital docking/berthing p 162 N87-29876

### ADACHI, TADASHI

A consideration to vibration control for a large space structures p 54 A87-32441

### ADAMIAN. A

Integrated control/structure design and robustness [SAE PAPER 861821] p 6 A87-32657

## ADAMIAN, ARMEN

Integrated control/structure design and robustness p 65 N87-22060

## ADAMS, LOUIS R.

Design, development and fabrication deployable/retractable truss beam model for large space structures application

### [NASA-CR-178287] p 35 N87-25349

### ADELMAN, H. M.

integrated structural electromagnetic optimization of

large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611

### ADELMAN, HENRY G.

Synergetic plane-change capability of a conceptual aeromaneuvering-orbital-transfer vehicle [AIAA PAPER 87-2565] p 92 A87-49615

AGGSON T

Potential modulation on the SCATHA spacecraft p 138 A87-34460

Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft [AD-A176815] p 140 N87-21024

AĞRAWAL, B.

Analysis of Intelsat V flight data

[AIAA PAPER 87-0784] p 16 A87-33679

AGRAWAL R I Design and fabrication of Stretched Rohini Satellite-1

p 83 N87-29006 AGRAWAL R N

Comparison of different attitude control schemes for large communications satellites

n 61 A87-50475 AJIMA, HIROMI

Development of sensors for remote manipulator system p 147 A87-32547 of Japanese Experiment Module AKIBA, RYOJIRO

Japanese space program p 143 A87-32285 ALBRIDGE R. G.

The Vanderbilt University neutral O-beam facility p 105 A87-32059 The production of low-energy neutral oxygen beams by grazing-incidence neutralization p 131 N87-26191

ALLAN, T. D. Ocean-ice panel report p 156 N87-20635

ALLEN, D. H. Dynamic response of a viscoelastic Timoshenko beam [AIAA PAPER 87-0890] p 16 A87-33708

ALLEN, JOHN L.

p 30 N87-22703 Status of the Mast experiment ALLUMS, S.

Space Station propulsion system test bed and control system testing results

[AIAA PAPER 87-1858] p 91 A87-45255 ALLUMS, S. I

A 25-LBF gaseous oxygen/gaseous hydrogen thruster for space station application p 98 N87-26132

## ALTMANN, THOMAS

Preliminary analysis of a prototype space solar power system

(ILR-MITT-168) p 79 N87-24532

## ALTON, T. JAMES

Evaluation of cryogenic system test options for the OTV on-orbit propellant depot [AIAA PAPER 87-1498] p 90 A87-43027

AMADIEU, PATRICE

Qualification of the faint object camera p 127 N87-20359

### AMBRUS, JUDITH H.

Space station: A program overview

p 171 N87-24496 AMIROUCHE, M. L.

Flexibility effects - Estimation of the stiffness matrix in the dynamics of a large structure p 23 A87-48714 AMOS, ANTHONY K.

Air Force basic research in dynamics and control of p 63 N87-20577 large space structures AN. SONG H.

Feasibility study on 8PSK, QPSK, TFM, by using CLASS for Space Station/TDRSS real measured channe

### ANDERSEN, G. C.

The dynamics and control of the Space Station polar platform

p 113 A87-45485

[AIAA PAPER 87-2600]

p 62 A87-50562 ANDERSEN GREGORY C

Analysis of on-orbit thermal characteristics of the 15-meter hoop/column antenna [NASA-TM-89137] p 45 N87-21021

ANDERSON, JOHN L.

Technology and applications - Convergence to a tether capability [AAS PAPER 86-244]

p 124 A87-38574

### ANDO, Y.

Two-time-scale design of robust controllers for large p 12 A87-32443 structure systems

### ANTIN JONATHAN F

An evaluation of menu systems for Space Station interfaces p 111 A87-33040

### ANTONIAK, ZENEN I.

Two-phase reduced gravity experiments for a space reactor design p8 N87-21154

### APPLEBY, A. JOHN

Regenerative fuel cells for space applications

p 84 N87-29938

### ARAL FUMILITO

Flexibility control of torsional vibrations of a large solar arrav p 12 A87-32442 Modeling and control of torsional vibrations in a flexible structure p 60 A87-50033

### ARAJ. K.

Nuclear propulsion systems for orbit transfer based on the particle bed reactor

[DE87-010060] p 99 N87-28405

### ARAKAWA, ATSUSHI

Control of a flexible space manipulator

p 99 A87-32449

## ARCHULETA, F. A.

High intensity 5 eV CW laser sustained 0-atom exposure facility for material degradation studies

p 105 A87-32060 High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p 141 N87-26186

ARCHULETA, F. H.

Mass spectrometers and atomic oxygen

p 141 N87-26176

p 164 A87-38740

## ARMSTRONG, F. S.

Robust controller synthesis for a large flexible space p 84 A87-32235 A spline-based parameter and state estimation

technique for static models of elastic surfaces [NASA-CR-180449] p 11 N87-30107

## ARNO, ROGER D.

Science and payload options for animal and plant research accommodations aboard the early Space

### [SAE PAPER 860953] ARNOLD, GRAHAM S.

Laboratory studies of atomic oxygen reactions with p 4 N87-26185

## ARTIUSHIN, L. M.

Problems of mechanical system configuration control p 149 A87-35877

## ASHIDA. AKIRA

Water recycling system using thermopervaporation p 46 A87-32458 p 46 A87-32459 Water recycling for Space Station Autonomous decentralized system concept for Space p 146 A87-32541 ATLAS G

SPOT/MEGS design and flight results obtained

p 103 N87-29009 Experiences of CNES and SEP on space mechanisms rotating at low speed p 104 N87-29868

ATWELL, W. Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026

AUBRUN, JEAN-NOEL Maximum likelihood identification using an array p 5 A87-32121

AÚFFRAY, P. The high performance solar array GSR3

## AUSTIN, ERIC M.

The design and analysis of passive damping for aerospace systems

[AIAA PAPER 87-0891]

AVDUYEVSKIY, V. S. Plans for industrialization of space discussed

# AWAZAWA, H.

Japanese data relay satellite system [AIAA PAPER 87-2199] p 154 A87-48585

p 81 N87-28972

p 58 A87-39644

p 157 N87-21979

AYDELOTT, J. C.	BANKS, H. T.	BAYES, STEPHEN A.
Temperature fields due to jet induced mixing in a typical	A spline-based parameter and state estimation	Regenerable non-venting thermal control subsystem for extravehicular activity
OTV tank	technique for static models of elastic surfaces [NASA-CR-180449] p 11 N87-30107	[SAE PAPER 860947] p 42 A87-38734
[AIAA PAPER 87-2017] p 93 A87-52247	[	BAZ, A.
AYDELOTT, JOHN C.	BANKS, PETER M. A crisis in the NASA space and earth sciences	Actuators for actively controlled space structures
Thermodynamic analysis and subscale modeling of space-based orbit transfer vehicle cryogenic propellant	programme p 112 A87-37968	p 59 A87-42816
resupply	BANTELL, M. H., JR.	Modified independent modal space control method for
[AIAA PAPER 87-1764] p 92 A87-48572	Precision pointing and control of flexible spacecraft	active control of flexible systems [NASA-CR-181065] p 34 N87-23980
Thermodynamic analysis and subscale modeling of	p 66 N87-22723	[NASA-CR-181065] p 34 N87-23980 A comparison between IMSC, PI and MIMSC methods
space-based orbit transfer vehicle cryogenic propellant	BARAONA, COSMO	in controlling the vibration of flexible systems
resupply	High power/large area PV systems	[NASA-CR-181156] p 36 N87-25605
[NASA-TM-89921] p 96 N87-22949	p 80 N87-26452	Effect of bonding on the performance of a
AZUMA, HISAO	BARAONA, COSMO R. Space station power system p 80 N87-26447	piezoactuator-based active control system
Solar concentrator system for experiments in the Space Station p 146 A87-32535	The space station power system p 81 N87-28960	[NASA-CR-181414] p 74 N87-29713
Station p 146 A87-32535	Status of space station power system	Optimum shape control of flexible beams by
Ð	p 84 N87-29915	piezo-electric actuators [NASA-CR-181413] p 40 N87-29898
В	BARBAY, GORDON J.	[tartort of the transfer
	Modeling of environmentally induced transients within	BEATTY, R.  Nuclear reactor power for an electrically powered orbital
BABCOCK, CHARLES D.  Design considerations for a one-kilometer antenna	satellites	transfer vehicle
stick	[AIAA PAPER 85-0387] p 7 A87-41611	[AIAA PAPER 87-1102] p 76 A87-41145
[AIAA PAPER 87-0871] p 15 A87-33635	BARBERIS, NEIL J.  Geostationary platforms - An international perspective	BEATTY, RICHARD
Identification of the zero-g shape of a space beam	p 121 A87-32288	Nuclear reactor power for a space-based radar. SP-100
[AIAA PAPER 87-0872] p 15 A87-33636	BARBIERI, E.	project
BABEL, HENRY W.	Control of multiple-mirror/flexible-structures in slew	[NASA-TM-89295] p 79 N87-25838
Microcrack resistant structural composite tubes for	maneuvers	BECK, JUERGEN W.
space applications p 106 A87-41022	[AIAA PAPER 87-2324] p 24 A87-50445	Highlights of the German Space Programme p 143 A87-32282
BACHTELL, E. E.	BARCLAY, J. A.	BECKMAN-DAVIES, C. S.
Box truss antenna technology status p 87 N87-24503	Magnetic refrigeration for space platforms [SAE PAPER 861724] p 118 A87-32613	SAGA: A project to automate the management of
BAE, GYOUNG H.	[SAE PAPER 861724] p 118 A87-32613 BAREISS, LYLE	software production systems
Optimal heading change with minimum energy loss for	Martin Marietta atomic oxygen Low Earth Orbit (LEO)	[NASA-CR-180276] p 10 N87-27412
a hypersonic gliding vehicle	simulation p 142 N87-26204	BECKMANN, K.
[AIAA PAPER 87-2568] p 136 A87-49618	BAREISS, LYLE E.	The capabilities of Eureca thermal control for future
BAGDIGIAN, ROBERT	Martin Marietta atomic oxygen beam facility	mission scenarios [SAE PAPER 860936] p 42 A87-38725
Air Evaporation closed cycle water recovery technology	p 139 A87-38622	System aspects of Columbus thermal control
- Advanced energy saving designs [SAE PAPER 860987] p 51 A87-38766	BARNES, A. V.  The Vanderbilt University neutral O-beam facility	[SAE PAPER 860938] p 150 A87-38727
BAILEY, M. C.	p 105 A87-32059	BEEVER, R.
Integrated structural electromagnetic optimization of	BARNES, W. L.	Radiation environments and absorbed dose estimations
large space antenna reflectors	Preliminary system concepts for MODIS - A moderate	on manned space missions p 139 A87-49026
[AIAA PAPER 87-0824] p 14 A87-33611	resolution imaging spectrometer for EOS	BEGIAN, YVETTE M.  Desirability of arms-in capability in space suits
Hoop/column and tetrahedral truss electromagnetic	p 126 A87-44186	[SAE PAPER 860951] p 49 A87-38738
tests p 87 N87-24504	BARRET, MICHAEL F.	BEHRENS, G.
BAILEY, MARION C.	Robust control of a large space antenna [AIAA PAPER 87-2253] p 86 A87-50417	High power solar array technologies
Controls-structures-electromagnetics interaction program p 69 N87-24502	BARRETT, M. F.	p 82 N87-28976
p g	Robust control for large space antennas	BEKEY, IVAN
BAINS, E. M.  Track and capture of the orbiter with the space station	p 87 N87-24499	Tethers in space; Proceedings of the International Conference, Arlington, VA, Sept. 17-19, 1986
remote manipulator system	BARTEVIAN, J.	p 123 A87-38567
[NASA-TM-89221] p 137 N87-25339	The high performance solar array GSR3	BELIAEV, M. IU.
BAINUM, PETER M.	p 81 N87-28972	Optimization of a program of experiments in connection
A review of modelling techniques for the open and	BARTHEL, J.  Contribution of the German Democratic Republic (East	with the operational planning of studies carried out with
closed-loop dynamics of large space systems	Germany) to the 'intercosmos' program of study of	a spacecraft p 148 A87-34208
p 12 A87-32337	materials in space aboard the orbiting station Salyut 6	BELISLE, J.
Tethers in space; Proceedings of the International	p 147 A87-32814	Nuclear propulsion systems for orbit transfer based on the particle bed reactor
Conference, Arlington, VA, Sept. 17-19, 1986 p 123 A87-38567	BARTOLI, C.	[DE87-010060] p 99 N87-28405
Minimum time attitude slewing maneuvers of a rigid	Status of the RITA - Experiment on EURECA [AIAA PAPER 87-0988] p 123 A87-38002	BELL, CHARLES E.
spacecraft	[AIAA PAPER 87-0988] p 123 A87-38002 BASAPUR, V. K.	Soft mounted momentum compensated pointing system
[NASA-CR-181130] p 72 N87-26038	Optimal trajectories for aeroassisted, coplanar orbital	for the Space Shuttle Orbiter p 59 A87-42817
The dynamics and control of large flexible space	transfer p 54 A87-31681	BELVIN, W. KEITH
structures X, part 1	BASSNER, H.	Quasi-static shape adjustment of a 15 meter diameter
[NASA-CR-181287] p 73 N87-27712	Status of the RITA - Experiment on EURECA	space antenna [AIAA PAPER 87-0869] p 15 A87-33633
BAKER, D. JAMES	[AIAA PAPER 87-0988] p 123 A87-38002	Dynamic analysis and experiment methods for a generic
A crisis in the NASA space and earth sciences programme p 112 A87-37968	BASSO, G. L.  Use of a video-photogrammetry system for the	space station model p 22 A87-41613
F 9	measurement of the dynamic response of the shuttle	Modeling of joints for the dynamic analysis of truss
BAKER, MARY  Comparison of the Craig-Bampton and residual flexibility	remote manipulator arm p 101 N87-20370	structures
methods of substructure representation	BASTARD, J. L.	[NASA-TP-2661] p 28 N87-20567
p 19 A87-34510	The high performance solar array GSR3	BELVIN, WENDELL K.
BALAS, GARY J.	p 81 N87-28972	Controls-structures-electromagnetics interaction
Identification of the zero-g shape of a space beam	BASTON, D.	program p 69 N87-24502
[AIAA PAPER 87-0872] p 15 A87-33636	Modal-survey testing of the Olympus spacecraft	BELYAYEV, M. YU.
BALMAIN, K. G.		
	p 152 A87-42266	Optimizing experimental programs in operational
Arc propagation, emission and damage on spacecraft	p 152 A87-42266  BATTRICK, B.  Proceedings of the European Symposium on Polar	
dielectrics p 143 N87-26952	p 152 A87-42266  BATTRICK, B. Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for	Optimizing experimental programs in operational planning of research carried out from spacecraft
dielectrics p 143 N87-26952  BALODIS, VILNIS	p 152 A87-42266  BATTRICK, B.  Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-Sensing (ESPOIR)	Optimizing experimental programs in operational planning of research carried out from spacecraft p 160 N87-29553  BENDIKSEN, ODDVAR O. Localization of vibrations in large space reflectors
dielectrics p 143 N87-26952  BALODIS, VILNIS  Space station power semiconductor package	p 152 A87-42266  BATTRICK, B. Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-Sensing (ESPOIR)  [ESA-SP-266] p 128 N87-20621	Optimizing experimental programs in operational planning of research carried out from spacecraft p 160 N87-29553  BENDIKSEN, ODDVAR O.
dielectrics p 143 N87-26952  BALODIS, VILNIS Space station power semiconductor package [NASA-CR-180829] p 81 N87-28825	p 152 A87-42266  BATTRICK, B. Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-Sensing (ESPOIR) [ESA-SP-266] p 128 N87-20621  BAUER, FRANK H.	Optimizing experimental programs in operational planning of research carried out from spacecraft p 160 N87-29553  BENDIKSEN, ODDVAR O. Localization of vibrations in large space reflectors [AIAA PAPER 87-0949] p 18 A87-33745  BENENATI, R.
dielectrics p 143 N87-26952  BALODIS, VILNIS Space station power semiconductor package [NASA-CR-180829] p 81 N87-28825  BANKS, BRUCE	p 152 A87-42266  BATTRICK, B. Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-Sensing (ESPOIR) [ESA-SP-266] p 128 N87-20621  BAUER, FRANK H. Space Infrared Telescope Facility/Multimission Modular	Optimizing experimental programs in operational planning of research carried out from spacecraft p 160 N87-29553  BENDIKSEN, ODDVAR O. Localization of vibrations in large space reflectors [AIAA PAPER 87-0949] p 18 A87-33745  BENENATI, R. Nuclear propulsion systems for orbit transfer based on
dielectrics p 143 N87-26952  BALODIS, VILNIS Space station power semiconductor package [NASA-CR-180829] p 81 N87-28825  BANKS, BRUCE An evaluation of candidate oxidation resistant materials for space applications in LEO	p 152 A87-42266  BATTRICK, B. Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-Sensing (ESPOIR) [ESA-SP-266] p 128 N87-20621  BAUER, FRANK H.	Optimizing experimental programs in operational planning of research carried out from spacecraft p 160 N87-29553  BENDIKSEN, ODDVAR O. Localization of vibrations in large space reflectors [AIAA PAPER 87-0949] p 18 A87-33745  BENENATI, R. Nuclear propulsion systems for orbit transfer based on the particle bed reactor
dielectrics p 143 N87-26952  BALODIS, VILNIS Space station power semiconductor package [NASA-CR-180829] p 81 N87-28825  BANKS, BRUCE An evaluation of candidate oxidation resistant materials for space applications in LEO [NASA-TM-100122] p 107 N87-25480	p 152 A87-42266  BATTRICK, B. Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-Sensing (ESPOIR) [ESA-SP-266] p 128 N87-20621  BAUER, FRANK H. Space Infrared Telescope Facility/Multimission Modular Spacecraft Attitude Control System conceptual design [AAS PAPER 86-031] p 56 A87-32736  BAUER, H. F.	Optimizing experimental programs in operational planning of research carried out from spacecraft p 160 N87-29553  BENDIKSEN, ODDVAR O. Localization of vibrations in large space reflectors [AIAA PAPER 87-0949] p 18 A87-33745  BENENATI, R. Nuclear propulsion systems for orbit transfer based on the particle bed reactor [DE87-010060] p 99 N87-28405
dielectrics p 143 N87-26952  BALODIS, VILNIS Space station power semiconductor package [NASA-CR-180829] p 81 N87-28825  BANKS, BRUCE An evaluation of candidate oxidation resistant materials for space applications in LEO [NASA-TM-100122] p 107 N87-25480 Neutral atomic oxygen beam produced by ion charge	p 152 A87-42266  BATTRICK, B. Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-Sensing (ESPOIR) [ESA-SP-266] p 128 N87-20621  BAUER, FRANK H. Space Infrared Telescope Facility/Multimission Modular Spacecraft Attitude Control System conceptual design [AAS PAPER 86-031] p 56 A87-32736  BAUER, H. F. Dynamic behavior of astronauts and satellites outside	Optimizing experimental programs in operational planning of research carried out from spacecraft p 160 N87-29553  BENDIKSEN, ODDVAR O. Localization of vibrations in large space reflectors [AIAA PAPER 87-0949] p 18 A87-33745  BENENATI, R. Nuclear propulsion systems for orbit transfer based on the particle bed reactor [DE87-010060] p 99 N87-28405  BENKLAASSENS, J.
dielectrics p 143 N87-26952  BALODIS, VILNIS Space station power semiconductor package [NASA-CR-180829] p 81 N87-28825  BANKS, BRUCE An evaluation of candidate oxidation resistant materials for space applications in LEO [NASA-TM-100122] p 107 N87-25480 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation	p 152 A87-42266  BATTRICK, B. Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-Sensing (ESPOIR) [ESA-SP-266] p 128 N87-20621  BAUER, FRANK H. Space Infrared Telescope Facility/Multimission Modular Spacecraft Attitude Control System conceptual design [AAS PAPER 86-031] p 56 A87-32736  BAUER, H. F. Dynamic behavior of astronauts and satellites outside an orbiting space station under the influence of thrust	Optimizing experimental programs in operational planning of research carried out from spacecraft p 160 N87-29553  BENDIKSEN, ODDVAR O. Localization of vibrations in large space reflectors [AIAA PAPER 87-0949] p 18 A87-33745  BENENATI, R. Nuclear propulsion systems for orbit transfer based on the particle bed reactor [DE87-01060] p 99 N87-28405  BENKLAASSENS, J. Status of series-resonant power conversion with high
dielectrics p 143 N87-26952  BALODIS, VILNIS  Space station power semiconductor package [NASA-CR-180829] p 81 N87-28825  BANKS, BRUCE  An evaluation of candidate oxidation resistant materials for space applications in LEO [NASA-TM-100122] p 107 N87-25480  Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p 131 N87-26188	p 152 A87-42266  BATTRICK, B. Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-Sensing (ESPOIR) [ESA-SP-266] p 128 N87-20621  BAUER, FRANK H. Space Infrared Telescope Facility/Multimission Modular Spacecraft Attitude Control System conceptual design [AAS PAPER 86-031] p 56 A87-32736  BAUER, H. F. Dynamic behavior of astronauts and satellites outside an orbiting space station under the influence of thrust p 52 A87-41686	Optimizing experimental programs in operational planning of research carried out from spacecraft p 160 N87-29553  BENDIKSEN, ODDVAR O. Localization of vibrations in large space reflectors [AIAA PAPER 87-0949] p 18 A87-33745  BENENATI, R. Nuclear propulsion systems for orbit transfer based on the particle bed reactor [DE87-01080] p 99 N87-28405  BENKLAASSENS, J. Status of series-resonant power conversion with high internal frequencies. Support in definition of space station
dielectrics p 143 N87-26952  BALODIS, VILNIS Space station power semiconductor package [NASA-CR-180829] p 81 N87-28825  BANKS, BRUCE An evaluation of candidate oxidation resistant materials for space applications in LEO [NASA-TM-100122] p 107 N87-25480 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p 131 N87-26188 An evaluation of candidate oxidation resistant	p 152 A87-42266  BATTRICK, B.  Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-Sensing (ESPOIR) [ESA-SP-266] p 128 N87-20621  BAUER, FRANK H.  Space Infrared Telescope Facility/Multimission Modular Spacecraft Attitude Control System conceptual design [AAS PAPER 86-031] p 56 A87-32736  BAUER, H. F.  Dynamic behavior of astronauts and satellites outside an orbiting space station under the influence of thrust p 52 A87-41666  BAUER, J. L.	Optimizing experimental programs in operational planning of research carried out from spacecraft p 160 N87-29553  BENDIKSEN, ODDVAR O. Localization of vibrations in large space reflectors [AIAA PAPER 87-0949] p 18 A87-33745  BENENATI, R. Nuclear propulsion systems for orbit transfer based on the particle bed reactor [DE87-01060] p 99 N87-28405  BENKLAASSENS, J. Status of series-resonant power conversion with high
dielectrics p 143 N87-26952  BALODIS, VILNIS  Space station power semiconductor package [NASA-CR-180829] p 81 N87-28825  BANKS, BRUCE  An evaluation of candidate oxidation resistant materials for space applications in LEO [NASA-TM-100122] p 107 N87-25480  Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p 131 N87-26188  An evaluation of candidate oxidation resistant materials	p 152 A87-42266  BATTRICK, B. Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-Sensing (ESPOIR) [ESA-SP-266] p 128 N87-20621  BAUER, FRANK H. Space Infrared Telescope Facility/Multimission Modular Spacecraft Attitude Control System conceptual design [AAS PAPER 86-031] p 56 A87-32736  BAUER, H. F. Dynamic behavior of astronauts and satellites outside an orbiting space station under the influence of thrust p 52 A87-41666  BAUER, J. L. An electrically conductive thermal control surface for	Optimizing experimental programs in operational planning of research carried out from spacecraft p 160 N87-29553  BENDIKSEN, ODDVAR O. Localization of vibrations in large space reflectors [AIAA PAPER 87-0949] p 18 A87-33745  BENENATI, R. Nuclear propulsion systems for orbit transfer based on the particle bed reactor [DE87-010060] p 99 N87-28405  BENKLAASSENS, J. Status of series-resonant power conversion with high internal frequencies. Support in definition of space station power interface
dielectrics p 143 N87-26952  BALODIS, VILNIS Space station power semiconductor package [NASA-CR-180829] p 81 N87-28825  BANKS, BRUCE An evaluation of candidate oxidation resistant materials for space applications in LEO [NASA-TM-100122] p 107 N87-25480 Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation p 131 N87-26188 An evaluation of candidate oxidation resistant	p 152 A87-42266  BATTRICK, B.  Proceedings of the European Symposium on Polar platform Opportunities and Instrumentation for Remote-Sensing (ESPOIR) [ESA-SP-266] p 128 N87-20621  BAUER, FRANK H.  Space Infrared Telescope Facility/Multimission Modular Spacecraft Attitude Control System conceptual design [AAS PAPER 86-031] p 56 A87-32736  BAUER, H. F.  Dynamic behavior of astronauts and satellites outside an orbiting space station under the influence of thrust p 52 A87-41666  BAUER, J. L.	Optimizing experimental programs in operational planning of research carried out from space-craft p 160 N87-29553  BENDIKSEN, ODDVAR O. Localization of vibrations in large space reflectors [AIAA PAPER 87-0949] p 18 A87-33745  BENENATI, R. Nuclear propulsion systems for orbit transfer based on the particle bed reactor [DE87-010060] p 99 N87-28405  BENKLAASSENS, J. Status of series-resonant power conversion with high internal frequencies. Support in definition of space station power interface [ESA-CR(P)-2319] p 79 N87-24533

The use of multidimensional scaling for facilities layout

- An application to the design of the Space Station

p 118 A87-33003

		DRANDI, G.
BENNETT, W. H.	BIED, BARBRA	BOBO, PH.
Practical issues in computation of optimal, distributed control of flexible structures	Analysis of crew functions as an aid in Space Station	
FAIAA DADED OF ALEXA	interior layout	SPOT solar array in-orbit deployment results evaluation p 83 N87-28986
Modeling and control of flexible structures	[SAE PAPER 860934] p 163 A87-38724	BOCKRIS, JOHN OM.
	BIGHAM, J.	Electrochemical processing of solid waste
BENNETT, WILLIAM H. p 29 N87-21388	Space Station Information System integrated communications concept	[NASA-CR-181128] p 137 N87-25443
Spectral factorization and homogenization methods for	TALLA DADED OF COOK	BODE, JOERG
modeling and control of flexible structures	[AIAA PAPEH 87-2228] p 114 A87-48606 BIGHAM, J., JR.	Stress and deformation analysis of lightweight
[AD-A179726] p 35 N87-24517	Space Station Information System requirements for	composite structures
BENNIGHOF, JEFFREY KENT	integrated communications	[MBB-UD-489/86] p 30 N87-22269
Modeling and control of flexible structures	[AIAA PAPER 87-2229] p 114 A87-48607	BODECHTEL, J.
p 28 N87-20564	BIGNIER, MICHEL	Land panel report p 128 N87-20634
BENTS, DAVID J.	Europe's future in space p 143 A87-32278	BODLEY, CARL S.
Coaxial tube array space transmission line	BILLINGS, W. W.	Tethered satellite program control strategy
characterization	Power management equipment for space applications [SAE PAPER 861621] p. 74 A87-29578	[AAS PAPER 86-221] p 123 A87-38570
[NASA-TM-89864] p 96 N87-22003	BIRD, G. A. p 74 A87-32578	BOER, M.
BENZ, H. F.	Nonequilibrium radiation during re-entry at 10 km/s	The Signe II gamma-ray burst experiment aboard the
A VHSIC general purpose processor		Prognoz 9 satellite p 150 A87-38443
p 116 N87-29145	BIRD, J. O. p 135 A87-43060	BOESSO, S.
BENZINGER, L.	Evaluation of carbon-carbon for space engine nozzle	Data management system architecture options for space stations
SAGA: A project to automate the management of	p 98 N87-26116	CCC (DVD CTD (CCC)
software production systems [NASA-CR-180276] p. 10 N87-27412	BIRNER, W.	[SES/DNP/TH/002/85] p 115 N87-28585 BOFILIOS, D. A.
[NASA-CH-1802/6] p 10 N87-27412 BERG, HP.	Status of the RITA - Experiment on EURECA	Vibrations and structurehome asia- is
	[AIAA PAPER 87-0988] p 123 A87-38002	Vibrations and structureborne noise in space station [NASA-CR-181381] p.39 N87-29590
Status of the RITA - Experiment on EURECA [AIAA PAPER 87-0988] p 123 A87-38002	BISHOP, L. R.	[NASA-CH-181381] p 39 N87-29590 BOLDEA, i.
[AIAA PAPER 87-0988] p 123 A87-38002 BERGAMASCHI, S.	Proposed CMG momentum management scheme for	Permanent-magnet linear alternators. I - Fundamental
On the dynamical atability of the annual to	space station	
On the dynamical stability of the space 'monorail'	[AIAA PAPER 87-2528] p 62 A87-50531	BOND, A. P 76 A87-39735
p 148 A87-34047	BISHOP, R. H.	A UK large diameter ion thruster for primary
A study of fluid transfer management in space	Proposed CMG momentum management scheme for	propulsion
[FTMS-RPT-006] p 97 N87-26059	space station [AIAA PAPER 87-2528] p 62 A87-50531	[AIAA PAPER 87-1031] p 89 A87-38015
Service Manipulator Arm (SMA) for a Robotic Servicing	[AIAA PAPER 87-2528] p 62 A87-50531 BJORKMAN, M. D.	BOOHER, CLETIS R.
Experiment (ROSE)	Space station integrated wall design and penetration	Space Station personal hygiene study
[ESA-CR(P)-2347] p 103 N87-28260	damage control. Task 3: Theoretical analysis of penetration	[SAE PAPER 860931] p 163 A87-38721
BERGMANN, E. V.	mechanics	BORDANO, ALDO
Mass property estimation for control of asymmetrical	[NASA-CR-179166] p 39 N87-28582	Space station control moment gyro control
satellites p 63 A87-52968	BLACK, DAVID C.	p 64 N87-20669
BERMAN, ALBERT	NASA's space program - Space Station: A status report	BOSSI, J. A.
Space station power semiconductor package	and a view of its value for space science	A laboratory simulation of flexible spacecraft control
[NASA-CR-180829] p 81 N87-28825 BERMAN, DOUGLAS	p 1 A87-32277	[AIAA PAPER 87-2325] p 24 A87-50446
A comparison of schoduling almost and a comparison of schoduling almost a comparison of schoduling a comparison of schoduling almost a comparison of schoduling almost a comparison of schoduling a comparison of	A crisis in the NASA space and earth sciences	BOSTIC, SUSAN W.
A comparison of scheduling algorithms for autonomous management of the Space Station electric energy	programme p 112 A87-37968	A Lanczos eigenvalue method on a parallel computer
system	Scientific customer needs - NASA user	[AIAA PAPER 87-0725] p 13 A87-33565
FAIAA DADED OZ GAOZ:	[AIAA PAPER 87-2196] p 119 A87-48582	Experiences with the Lanczos method on a parallel
BERNSTEIN, D. S. p 77 A87-50511	BLACKBURN, DAVID A.	computer p 21 A87-41159
Maximum Entropy/Optimal Projection (MEOP) control	Ideas for educational physics experiments in space	BOUQUET, F. L.
design synthesis: Optimal quantification of the major design	p 130 N87-25033	Spacecraft dielectric material properties and spacecraft
tradeoffs p.9 N87-22741	BLAIS, T.	charging p 105 A87-33100
BERNSTEIN, DENNIS S.	Service Manipulator Arm (SMA) for a Robotic Servicing	Space environmental effects on adhesives for the
OPUS: Optimal Projection for Uncertain Systems	Experiment (ROSE)	Gallieo spacecraft p 139 A87-38643
[AU-A176820] p 29 N87-21025	[ESA-CR(P)-2347] p 103 N87-28260	BOUQUET, FRANK L.
BERRY, ROBERT E.	BLAND, TIMOTHY J.	Design considerations for long-lived glass mirrors for
Geostationary platforms - An international perspective	Development status of a two-phase thermal	space p 123 A87-36531  BOURLAND, CHARLES T.
P 121 A87-32288	management system for large spacecraft	Space Station Food System
	[SAE PAPER 861828] p 41 A87-32662	CAT DADED ASSESS.
Advanced Solar GaAs Array (ASGA) experiment on EURECA: Flight objectives and instrument configuration	BLANKENSHIP, G. L.	BOURNE, GARRETT D. p 48 A87-38720
p 83 N87-28985	Modeling and control of flexible structures [AD-A177106] p. 29 N87-21388	Military space station implications
BERTRAM, A.		[AD-A180831] p 172 N87-26964
Dynamic qualification of spacecraft by means of modal	Spectral factorization and homogenization methods for modeling and control of flexible structures	BOWLES, DAVID E.
synthesis p 26 N87-20363	[AD-A179726] p 35 N87-24517	Composite tubes for the Space Station truss structure
BESHERS, G.	BLELLOCH, P. A.	p 20 A87-38601
SAGA: A project to automate the management of	Perturbation analysis of internal halancing for lightly	BOYDA, R. B.
software production systems	damped mechanical systems with dyroscopic and	EDC development and testing for the Space Station program
	circulatory forces p 22 A87-47812	ICAE DADED OCCUPA
BHANDARI, P.  Nuclear reactor power for an electrically person of the second se	BLELLOCH, PAUL	[SAE PAPER 860918] p 118 A87-38710 Integrated air revitalization system for Space Station
Nuclear reactor power for an electrically powered orbital transfer vehicle	Control/dynamics simulation for preliminary Space	
[AIAA DADED OF ALCOH	Station design	BRACCIO, MATTHEW A.
BHANDARI, PRADEEP	[AIAA PAPER 87-2641] p 61 A87-50486	Development of a standard connector for orbital
Nuclear reactor power for a space-based radar. SP-100	BLOCK, ROGER F.	replacement units for serviceable spacecraft
project project	Automated Subsystem Control for Life Support System	p 40 N87-29864
[NASA-TM-89295] p 79 N87-25838	(ASCLSS)	BRACHET, G.
BHAT, R. B.	[NASA-CR-172003] p 53 N87-29117	Remote sensing applications: Commercial issues and
Optimization of aerospace structures subjected to	BLOOMFIELD, HARVEY	opportunities for space station p 156 N87-20626
random vibration and fatigue constraints	Nuclear reactor power for a space-based radar. SP-100	BRADLEY, OBIE H., JR.
BHATI, RAVINDER p 29 N87-20599	project	Thermal design of the ACCESS erectable space truss
• • • •		BRADY, JOYCE p 42 A87-34469
Substructure analysis using NICE/SPAR and	BLUME, HANS-JUERGEN C.  Effects of space placeme discharge at the	An evaluation of candidate and the control of
applications of force to linear and nonlinear structures [NASA-CR-180317]	Effects of space plasma discharge on the performance of large antenna structures in low Earth orbit	An evaluation of candidate oxidation resistant materials for space applications in LEO
BICHLER, U. p 38 N87-27260		[MACA TM 400400]
Intelligent flywheel energy storage units with additional	Measurement apparatus and procedure for the	BRAND, TIMOTHY J.
functions for future space stations in near-earth orbits	determination of surface emissivities	Aeroassist flight experiment guidance, navigation and
[DGLH PAPER 86-172] p 57 A87-36762	[NASA-CASE-LAR-13455-1] p 29 N87-21206	CONTROL
BICKFORD, R. L.	BLUTH, B. J.	[AAS PAPER 86-042] p 133 A87-32744
Evaluation of carbon-carbon for space engine nozzle	Soviet space stations as analogs, second edition	BRANDHORST, HENRY W., JR.
p 98 N87-26116	[NASA-CR-180920] p 157 N87-21996	Alternative power generation concepts for space
BIED SPERLING, BARBRA	RO PONALD A	RPANDT C p 81 N87-28961

BO, RONALD A.

An evaluation of advanced extravehicular crew

p 134 A87-38781

enclosures [SAE PAPER 861009]

BRANDT, G.

[AIAA PAPER 87-2227]

Evolution of data management systems from Spacelab to Columbus

p 154 A87-48605

p 61 A87-50503

An Al-based model-adaptive approach to flexible

High capacity demonstration of honeycomb panel heat

Design of an advanced two-phase capillary cold plate [SAE PAPER 861829] p 41 A87-32663

The definition of the low earth orbital environment and

Measuring thermal expansion in large composite

p 41 A87-32666

p 41 A87-32663

p 43 A87-43103

p 20 A87-38612

pipes

[SAE PAPER 861833]

[AIAA PAPER 87-1599]

CHAMBERLIN, DAVID N.

its effect on thermal control materials

CHALMERS, D. R.

structures

structure control
[AIAA PAPER 87-2457]

CALISE, ANTHONY J.

Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation

p 49 A87-38750

p 46 N87-29217

p 50 A87-38764

p 153 A87-48157

The liquid droplet radiator in space: A parametric

Development of a water recovery subsystem based on Vapor Phase Catalytic Ammonia Removal (VPCAR)

The problem of radiation exposure in the Space

CALEDONIA, GEORGE E.

sensors and actuators

[AIAA PAPER 87-0959]

CALICO, R. A.

CALISE, A. J.

control

A high flux pulsed source of energetic atomic oxygen

The effects of structural perturbations on decoupled

Optimal vibration control by the use of piezoceramic

Pulsed source of energetic atomic oxygen

p 139 A87-38623

p 108 N87-26189

p 35 N87-25359

p 18 A87-33751

BRDAR, MARKO

BROWN, NORMAN S. Evaluation of cryogenic system test options for the OTV on-orbit propellant depot [AIAA PAPER 87-1498] p 90 A87-43027 Advanced long term cryogenic storage systems p 94 N87-21142  BROWN, ROBERT A. A crisis in the NASA space and earth sciences programme p 112 A87-37968  BRUZZI, S. Panel report on new approaches to calibration and validation p 157 N87-20638  BRYANT, TIMOTHY D. Vapor fragrancer [NASA-CASE-LAR-13680-1] p 165 N87-25561  BUCKALEW, V. Space station momentum management p 64 N87-20668	An advanced technology space station for the year 2025, study and concepts [NASA-CR-178208] p 120 N87-20340  BYUN, KUK WHAN A new concept of generalized structural filtering for active vibration control synthesis	in the day sector of a geosynchronous orbit p 158 N87-26953  CAUGHEY, T. K. Positive position feedback control for large space structures [AIAA PAPER 87-0902] p 17 A87-33713  CAUGHEY, THOMAS Vibration suppression by stiffness control p 66 N87-22730  CAVALLARO, JOSEPH H. A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishmen [AD-A179106] p 161 N87-23673  CAWOOD, G. W. Evaluation of carbon-carbon for space engine nozzle
p 7 A87-37298  BROWN, NORMAN S. Evaluation of cryogenic system test options for the OTV on-orbit propellant depot [AIAA PAPER 87-1498] p 90 A87-43027 Advanced long term cryogenic storage systems p 94 N87-21142  BROWN, ROBERT A. A crisis in the NASA space and earth sciences programme p 112 A87-37968  BRUZZI, S. Panel report on new approaches to calibration and validation p 157 N87-20638  BRYANT, TIMOTHY D. Vapor fragrancer [NASA-CASE-LAR-13680-1] p 165 N87-25561	Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 103 N87-29118  BUSQUETS, A. M.  Electronic control/display interface technology	in the day sector of a geosynchronous orbit p 158 N87-26953  CAUGHEY, T. K. Positive position feedback control for large space structures [AIAA PAPER 87-0902] p 17 A87-33711  CAUGHEY, THOMAS Vibration suppression by stiffness control p 66 N87-22730  CAVALLARO, JOSEPH H. A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  CAWOOD, G. W. Evaluation of carbon-carbon for space engine nozzle p 98 N87-26116
p 7 A87-37298  BROWN, NORMAN S. Evaluation of cryogenic system test options for the OTV on-orbit propellant depot [AIAA PAPER 87-1498] p 90 A87-43027 Advanced long term cryogenic storage systems p 94 N87-21142  BROWN, ROBERT A. A crisis in the NASA space and earth sciences programme BRUZZI, S. Panel report on new approaches to calibration and validation BRYANT, TIMOTHY D. Vapor fragrancer	Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 103 N87-29118  BUSQUETS, A. M.  Electronic control/display interface technology p 88 N87-29161  BUSSOLARI, STEVEN Human factors in space station architecture 2. EVA access facility: A comparative analysis of 4 concepts for on-orbit space suit servicing [NASA-TM-86856] p 52 N87-24064  BUTTERFIELD, A. J. An advanced technology space station for the year 2025, study and concepts [NASA-CR-178208] p 120 N87-20340	in the day sector of a geosynchronous orbit p 158 N87-26953  CAUGHEY, T. K. Positive position feedback control for large space structures [AIAA PAPER 87-0902] p 17 A87-33711  CAUGHEY, THOMAS Vibration suppression by stiffness control p 66 N87-22730  CAVALLARO, JOSEPH H. A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677  CAWOOD, G. W.
p 7 A87-37298  BROWN, NORMAN S. Evaluation of cryogenic system test options for the OTV on-orbit propellant depot [AIAA PAPER 87-1498] p 90 A87-43027 Advanced long term cryogenic storage systems p 94 N87-21142  BROWN, ROBERT A. A crisis in the NASA space and earth sciences programme p 112 A87-37968  BRUZZI, S. Panel report on new approaches to calibration and validation p 157 N87-20638  BRYANT, TIMOTHY D.	Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 103  BUSQUETS, A. M.  Electronic control/display interface technology p 88 N87-29161  BUSSOLARI, STEVEN Human factors in space station architecture 2. EVA access facility: A comparative analysis of 4 concepts for on-orbit space suit servicing [NASA-TM-86856] p 52 N87-24064  BUTTERFIELD, A. J. An advanced technology space station for the year 2025, study and concepts	in the day sector of a geosynchronous orbit p 158 N87-26953  CAUGHEY, T. K. Positive position feedback control for large space structures [AIAA PAPER 87-0902] p 17 A87-33711  CAUGHEY, THOMAS Vibration suppression by stiffness control p 66 N87-22730  CAVALLARO, JOSEPH H. A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677
p 7 A87-37298  BROWN, NORMAN S.  Evaluation of cryogenic system test options for the OTV on-orbit propellant depot [AIAA PAPER 87-1498] p 90 A87-43027 Advanced long term cryogenic storage systems p 94 N87-21142  BROWN, ROBERT A.  A crisis in the NASA space and earth sciences programme p 112 A87-37968  BRUZZI, S.  Panel report on new approaches to calibration and	Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 103 N87-29118  BUSQUETS, A. M.  Electronic control/display interface technology p 88 N87-29161  BUSSOLARI, STEVEN Human factors in space station architecture 2. EVA access facility: A comparative analysis of 4 concepts for on-orbit space suit servicing [NASA-TM-86856] p 52 N87-24064  BUTTERFIELD, A. J.	in the day sector of a geosynchronous orbit p 158 N87-26953  CAUGHEY, T. K. Positive position feedback control for large space structures [AIAA PAPER 87-0902] p 17 A87-33711  CAUGHEY, THOMAS Vibration suppression by stiffness control p 66 N87-22730  CAVALLARO, JOSEPH H. A quantitative comparison of several orbital maneuvering vehicle configurations for satellite repair/replenishment
p 7 A87-37298  BROWN, NORMAN S.  Evaluation of cryogenic system test options for the OTV on-orbit propellant depot [AIAA PAPER 87-1498] p 90 A87-43027 Advanced long term cryogenic storage systems p 94 N87-21142  BROWN, ROBERT A.  A crisis in the NASA space and earth sciences programme p 112 A87-37968	Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 103 N87-29118  BUSQUETS, A. M.  Electronic control/display interface technology p 88 N87-29161  BUSSOLARI, STEVEN  Human factors in space station architecture 2. EVA access facility: A comparative analysis of 4 concepts for on-orbit space suit servicing [NASA-TM-886561] p 52 N87-24064	in the day sector of a geosynchronous orbit p 158 N87-26953  CAUGHEY, T. K. Positive position feedback control for large space structures [AIAA PAPER 87-0902] p 17 A87-33711  CAUGHEY, THOMAS Vibration suppression by stiffness control p 66 N87-22730  CAVALLARO, JOSEPH H. A quantitative comparison of several orbital maneuvering
p 7 A87-37298  BROWN, NORMAN S.  Evaluation of cryogenic system test options for the OTV on-orbit propellant depot [AIAA PAPER 87-1498] p 90 A87-43027 Advanced long term cryogenic storage systems p 94 N87-21142  BROWN, ROBERT A.  A crisis in the NASA space and earth sciences programme p 112 A87-37968	Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 103 N87-29118  BUSQUETS, A. M. Electronic control/display interface technology p 88 N87-29161  BUSSOLARI, STEVEN Human factors in space station architecture 2. EVA access facility: A comparative analysis of 4 concepts for on-orbit space suit servicing	in the day sector of a geosynchronous orbit p 158 N87-26953  CAUGHEY, T. K. Positive position feedback control for large space structures [AIAA PAPER 87-0902] p 17 A87-33711  CAUGHEY, THOMAS Vibration suppression by stiffness control p 68 N87-22730  CAVALLARO, JOSEPH H.
p 7 A87-37298  BROWN, NORMAN S.  Evaluation of cryogenic system test options for the OTV on-orbit propellant depot [AIAA PAPER 87-1498] p 90 A87-43027 Advanced long term cryogenic storage systems p 94 N87-21142  BROWN, ROBERT A.  A crisis in the NASA space and earth sciences	Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 103 N87-29118  BUSQUETS, A. M.  Electronic control/display interface technology p 88 N87-29161  BUSSOLARI, STEVEN Human factors in space station architecture 2. EVA access facility: A comparative analysis of 4 concepts for	in the day sector of a geosynchronous orbit p 158 N87-26953  CAUGHEY, T. K. Positive position feedback control for large space structures [AIAA PAPER 87-0902] p 17 A87-33711  CAUGHEY, THOMAS Vibration suppression by stiffness control
p 7 A87-37298  BROWN, NORMAN S.  Evaluation of cryogenic system test options for the OTV on-orbit propellant depot [AIAA PAPER 87-1498] p 90 A87-43027 Advanced long term cryogenic storage systems p 94 N87-21142	Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 103 N87-29118  BUSQUETS, A. M.  Electronic control/display interface technology p 88 N87-29161  BUSSOLARI, STEVEN Human factors in space station architecture 2. EVA	in the day sector of a geosynchronous orbit p 158 N87-26953  CAUGHEY, T. K. Positive position feedback control for large space structures [AIAA PAPER 87-0902] p 17 A87-33711  CAUGHEY, THOMAS
p 7 A87-37298  BROWN, NORMAN S.  Evaluation of cryogenic system test options for the OTV on-orbit propellant depot [AIAA PAPER 87-1498] p 90 A87-43027  Advanced long term cryogenic storage systems	Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 103 N87-29118 BUSQUETS, A. M. Electronic control/display interface technology p 88 N87-29161	in the day sector of a geosynchronous orbit p 158 N87-26953  CAUGHEY, T. K. Positive position feedback control for large space structures [AIAA PAPER 87-0902] p 17 A87-33711
p 7 A87-37298  BROWN, NORMAN S.  Evaluation of cryogenic system test options for the OTV on-orbit propellant depot  [AIAA PAPER 87-1498] p 90 A87-43027	Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 103 N87-29118  BUSQUETS, A. M.  Electronic control/display interface technology	in the day sector of a geosynchronous orbit p 158 N87-26953  CAUGHEY, T. K. Positive position feedback control for large space structures
p 7 A87-37298  BROWN, NORMAN S.  Evaluation of cryogenic system test options for the OTV on-orbit propellant depot	Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 103 N87-29118 BUSQUETS, A. M.	in the day sector of a geosynchronous orbit p 158 N87-26953 CAUGHEY, T. K.
p 7 A87-37298	Mobile remote manipulator vehicle system	in the day sector of a geosynchronous orbit p 158 N87-26953
p 7 A87-37298		in the day sector of a geosynchronous orbit
Tious also circulated the special control of	- 04 NOT 04E01	
Real-time simulation for Space Station	assembled from 5-meter erectable struts	On the possibility of a several-kilovolt differential charge
BROWN, BLAINE W.	Design, construction, and utilization of a space station	CATANI, J. P.
requirements [SAE PAPER 861008] p 134 A87-38780	[AIAA PAPER 87-1482] p 43 A87-43014 BUSH, HAROLD G.	The Canadian Robotic System for the Space Station [AIAA PAPER 87-1677] p 100 A87-41153
An evaluation of options to satisfy Space Station EVA	spacecraft thermal management	CASWELL, DOUGLAS  The Canadian Robotic System for the Space Station
RROSSEL, KENNETH S.	The benefit of phase change thermal storage for	structures p 26 N87-20362
[NASA-CR-178276] p 8 N87-21020	BUSBY, M. S.	Effect of modal damping in modal synthesis of spacecraft
NASA IOC space station. Executive summary	thruster orbit transfer vehicle [AIAA PAPER 87-2027] p 77 A87-45363	CASTELLANI, ANTONIO
The results of a limited study of approaches to the design, fabrication, and testing of a dynamic model of the	Performance of an SP-100/pulsed electrothermal	[AIAA PAPER 87-2211] p 154 A87-48596
BROOKS, GEORGE W.	BURTON, R. L.	pressurized module element
finite-element models p 34 N87-24505	programme p 112 A87-37968	CASSISA, G. C. The hardware/software architecture of the Columbus
Application of physical parameter identification to	A crisis in the NASA space and earth sciences	[SAE PAPER 860990] p 134 A87-38767
BRONOWICKI, ALLEN J.	BURNS JOSEPH A	Space Station EVA systems trade-off model
BRODSKY, R. F. Trends in space transportation p 168 A87-41572	large flexible structures	CARSON, MAURICE A.
vaporization methods p 109 N87-26190	estimation and optimal control of aeroelastic systems and	System p 104 N87-29865
Production of pulsed atomic oxygen beams via laser	Modeling and computational algorithms for parameter	system for the Space Station Remote Manipulator
[NASA-CR-181163] p 141 N87-26173	BURNS. J. A.	CARROLL, THOMAS W.  The design and development of a mobile transporter
Effects	Photovoltaic Generators in Space [ESA-SP-267] p 81 N87-28959	Station docking p 138 N87-29878
vaporization methods p 106 A87-38625 Proceedings of the NASA Workshop on Atomic Oxygen	Proceedings of the Fifth European Symposium on	An electromechanical attenuator/actuator for Space
Production of pulsed atomic oxygen beams via laser	BURKE, W. R.	CARROLL, MONTY B.
BRINZA, DAVID E.	a spatially distributed actuator p 23 A87-50232	open issues propulsion - 7 otential uses and p 124 A87-40510
p 98 N87-26131	Active vibration control of a simply supported beam using	CARROLL, JOSEPH A.  Electrodynamic tether propulsion - Potential uses and
[AIAA PAPER 87-1858] p 91 A87-45255 Space station propulsion test bed: A complete system	programme p 112 A87-37966 BURKE, SHAWN E.	for space station application p 98 N87-26132
system testing results	A crisis in the NASA space and earth sciences	A 25-LBF gaseous oxygen/gaseous hydrogen thruster
Space Station propulsion system test bed and control	BURKE, KEVIN C.	CARRASQUILLO, E. A.
ROILEY G. I.	[DE87-009121] p 103 N87-27408	[NASA-TM-87826] p 115 N87-27443
plume [AIAA PAPER 87-2121] p 62 A87-52252	truss assembly	Mass storage systems for data transport in the early space station era 1992-1998
Effect of nozzle geometry on the resistojet exhaust	BURGESS, T. W.  Remote handling facility and equipment used for space	[AIAA PAPER 87-2203] p 113 A87-48588
BREYLEY, LORANELL	•	Data capture and processing
gas-phase trace contaminants p 52 A87-53979	Space Station tracking subsystem sensor evaluation p 85 A87-45520	CARPER, RICHARD
A simulation model for the analysis of Space Station	BURGESS, GREGG E.	aerothermodynamics studies p 127 A87-52450
evolutionary Space Station application [SAE PAPER 860993] p 51 A87-38770	MD, Mar. 20, 21, 1986 p 2 A87-53082	CARLOMAGNO, GIOVANNI M.  The tethered satellite system for low density
Supercritical water oxidation - Concept analysis for	Twenty-fourth Goddard Memorial Symposium, Greenbelt,	programme p 112 A87-37968
[SAE PAPER 860916] p 47 A87-38708	BURDETT, GERALD L.  The human quest in space; Proceedings of the	A crisis in the NASA space and earth sciences
Reference Configuration	p 155 A87-53559	CANIZARES, CLAUDE R.
contaminant concentrations in the NASA Space Station	instrument sector of the GDR contributions	design tool [AIAA PAPER 87-0713] p 6 A87-33557
BREWER, DANA A.  Effects of varying environmental parameters on trace	The GDR and the Soviet space program - The optical	ASTROS - A multidisciplinary automated structural
programme p 112 A87-37968	BURCZIK, KLAUS	CANFIELD, R.
A crisis in the NASA space and earth sciences	Space p 126 A87-44533	[NASA-CR-180276] p 10 N87-27412
BRETHERTON, FRANCIS	BUNNER, ALAN N.  Optical arrays for future astronomical telescopes in	SAGA: A project to automate the management of software production systems
Space station propulsion-ECLSS interaction study [NASA-CR-175093] p 54 N87-29594	Space Station - All change? p 154 A87-50792	CAMPBELL, ROY H.
[AIAA PAPER 87-2018] p 92 A87-45357	BULLOCH, CHRIS	p 98 N87-26131
destratification	p 33 N87-22751	Space station propulsion test bed: A complete system
BRENNAN, SCOTT M.  Mixing-induced ullage condensation and fluid	BUGG, FRANK M.  Space station structures and dynamics test program	[NASA-CR-180301] p 137 N87-26927
noxibre opacionary	(747-67-7-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1	optimization problems
dynamic design verification and qualification of large	Robust control of a large space antenna [AIAA PAPER 87-2253] p 86 A87-50417	Singular perturbation analysis of AOTV related trajectory
Recent developments and future trends in structural	BUGAJSKI, DANIEL J.	[AIAA PAPER 87-2568] p 136 A87-49618
BREITBACH, E.	Quick-disconnect inflatable seal assembly [NASA-CASE-KSC-11368-1] p 102 N87-25583	Optimal heading change with minimum energy loss for a hypersonic gliding vehicle
p 131 N87-26188		

Radiation protection problems for the Space Station and

approaches to their mitigation

BUEHLER, KURT D.

p 154 A87-49030

[SAE PAPER 860968]

[SAE PAPER 860985]

[DGLR PAPER 86-175]

BUCKNER, GERALD L.

approach [AD-A182605]

BUDININKAS, P.

BUECKER, H.

Station

PERSONAL AUTHOR INDEX CHAN, JOHN D. An analysis of space station motion subject to the parametric excitation of periodic elevator motion [AD-A179235] p 68 N87-23681 CHAPMAN, J. M. Nonlinear transient analysis of joint dominated structures [AIAA PAPER 87-0892] p 17 A87-33709 Dynamics of trusses having nonlinear joints p 32 N87-22724 Equivalent beam modeling using numerical reduction techniques p 32 N87-22725 CHARON, W. Investigation for damping design and related nonlinear vibrations of spacecraft structures [EMSB-64/85] p 35 N87-24516 CHEN, CHUNG-WEN Single-mode projection filters for identification and state estimation of flexible structures [AIAA PAPER 87-2387] p 24 A87-50471 Projection filters for modal parameter estimate for flexible structures [NASA-CR-180303] p 38 N87-26583 CHEN. G. Modeling, stabilization and control of serially connected beams p 21 A87-41052 CHEN, ING-YOMN Development status of a two-phase thermal management system for large spacecraft [SAE PAPER 861828] p 41 A87-32662 CHEN. J. C. Structural dynamics system model reduction p 32 N87-22727 System identification for large space structure damage p 33 N87-22750 CHEN. J.-C. Structural control by the use of piezoelectric active p 69 N87-24509 CHEN. JAY Vibration suppression by stiffness control p.66 N87-22730 CHEN, JAY C. Verification of large beam-type space structures p 31 N87-22712 CHEN, JAY-C. On the control of structures by applied thermal p 33 N87-22747 CHEN, JAY-CHUNG On orbit damage assessment for large space [AIAA PAPER 87-0870] p 15 A87-33634 On sine dwell or broadband methods for modal testing [AIAA PAPER 87-0961] p 18 A87-33752 CHENG. U. GPS applications to the Space Station p 136 A87-45525 CHESNEY, JAMES Data storage systems technology for the Space Station [AIAA PAPER 87-2202] D 113 A87-48587 CHETTY, P. R. K. New power processor interfaces MMS power module outouts p 77 A87-48264 CHEVERS, EDWARD S. Space Station integration and verification concepts p 84 A87-31461 CHIE. CHAK-MING FDMA system design and analysis for Space Station p 85 A87-45483 Contamination assessment for OSSA space station IOC payloads [NASA-CR-4091] p 53 N87-26086 CHIQU. J. C. Evaluation of constraint stabilization procedures for multibody dynamical systems [AIAA PAPER 87-0927] p 7 A87-33728 CHOI, C. S. Dynamic finite element modeling of flexible structures [AD-A177168] p 30 N87-22252 CHOI, KYUNG K. Shape design sensitivity analysis and optimal design of structural system: [NASA-CR-181095] p 37 N87-26370

CHOW, E.

transfer vehicle

NASA-TM-892951

CHRISTENSEN, E. R.

[AD-A177168]

CHOW, EDWIN

[AIAA PAPER 87-1102]

Nuclear reactor power for a space-based radar. SP-100

Dynamic finite element modeling of flexible structures

p 79 N87-25838

p 30 N87-22252

structures

COCHRAN, THOMAS H.

[NASA-TM-100140]

CLODFELTER, KEN Hydrogen-oxygen thruster with no products of combustion in exhaust plume [AIAA PAPER 87-1775] CLOPP, WILLIAM An advanced geostationary communications platform COCHRAN, J. E., JR. Analytical solutions for static elastic deformations of wire [AIAA PAPER 87-0720] Initial investigations into the damping characteristics of Nuclear reactor power for an electrically powered orbital wire rope vibration isolators [NASA-CR-180698] p 76 A87-41145 Space Station/Shuttle Orbiter

CHRISTIAN, E. L. Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger [AIAA PAPER 87-1540] CHROSTOWSKI, J. D. MOVER II - A computer program for verifying reduced-order models of large dynamic systems [SAE PAPER 861790] A computer program for model verification of dynamic Application of reanalysis techniques in dynamic analysis of spacecraft structures CHU, JAMES Phase change water recovery for Space Station -Parametric testing and analysis [SAE PAPER 860986] CHU. OI PING Maximum likelihood parameter identification of flexible spacecraft [ETN-87-902351 CHUBB, DONALD L. Liquid sheet radiator [AIAA PAPER 87-1525] Performance characteristics of a combination solar photovoltaic heat engine energy converter [NASA-TM-89908] CHULLEN, CINDA Pre- and post-treatment techniques for spacecraft water recovery [SAE PAPER 860982] CHUNG, SHIRLEY Y. Degradation studies of SMRM teflon O-atom degradation mechanisms of materials CHURCH, S. M. Experimental characterization of deployable trusses and ioints CHUTJIAN, ARA Variable energy, high flux, ground-state atomic oxygen source [NASA-CASE-NPO-16640-1-CU] CIMINO, JOBEA The Earth Observing System (EOS) synthetic aperture radar (SAR) CINTALA, MARK J. Experimentation in planetary geology CIOCCA, JOSEPH A Evaluation of regenerative portable life support system options [SAE PAPER 860948] CLARK, WALTON Communication and Data Management Systems for an orbiting platform CLASS, BRIAN F. Space Infrared Telescope Facility/Multimission Modular Spacecraft Attitude Control System conceptual design [AAS PAPER 86-031] CLEARWATER, SCOTT Radiation shielding requirements on long-duration space missions [AD-A177512] CLEVENSON, SHERMAN A. Documentation of the space station/aircraft acoustic apparatus [NASA-TM-891111 CLIFF. E. M. Modeling and computational algorithms for parameter estimation and optimal control of aeroelastic systems and large flexible structures [AD-A1833021

p 44 A87-44843

p 5 A87-32639

p 31 N87-22710

p 21 A87-38824

p 51 A87-38765

p 38 N87-27705

p 78 N87-23028

p 50 A87-38761

p 106 A87-38641

p 141 N87-26178

p 33 N87-22749

p8 N87-21661

p 126 A87-44187

p 124 A87-40319

p 49 A87-38735

p 112 A87-40359

p 56 A87-32736

p 140 N87-21991

p 140 N87-20795

p 11 N87-29893

p 91 A87-45196

p 125 A87-43165

p 6 A87-33561

p 28 N87-20569

dynamics during

p 65 N87-22708

p 80 N87-26144

A new approach for vibration control in large space tructures p 33 N87-22743

Space station electrical power system

COHEN, H. A. Automatic charge control system for geosynchronous satellites p 87 N87-26960 COHEN, MARC M. Human factors in space station architecture 2. EVA access facility: A comparative analysis of 4 concepts for on-orbit space suit servicing [NASA-TM-86856] p 52 N87-24064 COHEN, S. A. Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams p 109 N87-26200 COLE, R. K. The Vanderbilt University neutral O-beam facility p 105 A87-32059 COLEMAN, MARK Liquid propulsion technology for expendable and STS launch vehicle transfer stages [AIAA PAPER 87-1934] p 92 A87-45311 COLES-HAMILTON, CAROLYN Selection of high temperature thermal energy storage materials for advanced solar dynamic space power [NASA-TM-89886] p 78 N87-22174 COLIZZI, E. Infrared test technique validation on the Olympus satellite [SAE PAPER 8609391 p 150 A87-38728 COLOMBO, GERALD V. Pre- and post-treatment techniques for spacecraft water [SAE PAPER 860982] p 50 A87-38761 COLWELL, GENE T. Evaluation of Space Station thermal control [SAE PAPER 860998] p 42 A87-38775 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181009] p 45 N87-26072 Development of an emulation-simulation thermal control model for space station application [NASA-CR-180312] p 45 N87-26936 Development of an emulation-simulation thermal control model for space station application [NASA-CR-181221] p 45 N87-27702 COMPOSTIZO, C. Service Manipulator Arm (SMA) for a Robotic Servicing Experiment (ROSE) [ESA-CR(P)-2347] p 103 N87-28260 CONLEY, G. Space Station gas-grain simulation facility - Application to exobiology p 127 A87-53002 CONRAD, P. Dynamic qualification of spacecraft by means of modal synthesis p 26 N87-20363 COOK, EARL L. Process control and data acquisition for commercial materials processing in space [AIAA PAPER 87-2197] p 113 A87-48583 COOPER, PAUL A. Dynamic and attitude control characteristics of an International Space Station [AIAA PAPER 87-0931] p 57 A87-33731 Interdisciplinary analysis procedures in the modeling and control of large space-based structures p 22 A87-42678 Dual keel space station control/structures interaction study p 67 N87-22737 CORNWELL, PHILLIP J. Localization of vibrations in large space reflectors [AIAA PAPER 87-0949] p 18 A87-33745 CORONADO, A. R. Space station integrated wall design and penetration damage control [NASA-CR-179165] p 39 N87-28581 COSTA, S. RICHARD The Consultative Committee for Space Data Systems Standards program [AIAA PAPER 87-2204] p 113 A87-48589 COTTS, D. B. Spacecraft dielectric material properties and spacecraft charging p 105 A87-33100 COULTER, DANIEL R Production of pulsed atomic oxygen beams via laser vaporization methods p 106 A87-38625 O-atom degradation mechanisms of materials p 141 N87-26178 Production of pulsed atomic oxygen beams via laser vaporization methods p 109 N87-26190 COVAULT, CRAIG

p 132 A87-32006

p 149 A87-34594

Space Station EVA simulation demonstrates orbital

International cooperation in space

Thermodynamic analysis and subscale modeling of space-based orbit transfer vehicle cryogenic propellant

# COX, KENNETH J.

COX, KENNETH J.	CVETANOVIC, R. J.	space-based orbit transfer vehicle cryogenic propellant
Shuttle orbit flight control design lessons - Direction for	Kinetics and mechanisms of some atomic oxygen reactions p 141 N87-26179	resupply
Space Station p 58 A87-37295 COYNER, J. V.	CYROT D. N.	[NASA-TM-89921] p 96 N87-22949
Box truss antenna technology status	Sampled nonlinear control for large angle maneuvers	<b>DEININGER, W.</b> Nuclear reactor power for an electrically powered orbital
p 87 N87-24503	of flexible spacecraft p 71 N87-25358	transfer vehicle
CRAIG, ROY R., JR.	CZAJKOWSKI, EVA A.  Spillover stabilization and decentralized modal control	[AIAA PAPER 87-1102] p 76 A87-41145
Lanczos modes for reduced-order control of flexible structures p 33 N87-22739	of large space structures	DEININGER, WILLIAM  Nuclear reactor power for a space-based radar. SP-100
CRAVEN. P. D.	[AIAA PAPER 87-0903] p 17 A87-33712	project
Potential modulation on the SCATHA spacecraft	•	[NASA-TM-89295] p 79 N87-25838
p 138 A87-34460	D	DĚKAM, J.
Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft	_	EURECA application of the Retractable Advanced Rigid Array (RARA) solar array p 82 N87-28973
[AD-A176815] p 140 N87-21024	D'ELEUTERIO, G. M. T.	Array (RARA) solar array p 82 N87-28973 DELAFUENTE. E.
CRAWLEY F.F.	Dynamics of gyroelastic spacecraft p 59 A87-47811	Service Manipulator Arm (SMA) for a Robotic Servicing
Incorporation of the effects of material damping and nonlinearities on the dynamics of space structures	DABROWSKI, DAVID	Experiment (ROSE)
p 21 A87-40075	Optimization of heat rejection subsystem for solar dynamic Brayton cycle power system	(20) 01/6 / == 11
Preliminary design, analysis, and costing of a dynamic	[SAE PAPER 860999] p 43 A87-38776	DELAPLACE, JEAN ERATO orbital transfer vehicle with electronuclear power
scale model of the NASA space station	DAECH, A. F.	Study of the associated electronuclear generator
[NASA-CR-4068] p 36 N87-25606 CRAWLEY, EDWARD F.	The production of low-energy neutral oxygen beams by	p 75 A87-36944
Material damping in aluminum and metal matrix	grazing-incidence neutralization p 131 N87-26191	DELFOUR, M. C.
composites p 106 A87-49797	DAHLGREN, J. B. Control technology overview in CSI	Modeling, stabilization and control of serially connected beams p 21 A87-41052
The coupled dynamics of fluids and spacecraft in low	p 69 N87-24507	DELIL, A. A. M.
gravity and low gravity fluid measurement	DALEY, S.	Quality monitoring in two-phase heat transport systems
Development of intelligent structures using finite control	Attitude control of a spacecraft using an extended	for large spacecraft
elements in a hierarchic and distributed control system	self-organizing fuzzy logic controller p 59 A87-41617	[SAE PAPER 860959] p 42 A87-38743
[AD-A179711] p 72 N87-25805	DALTON, JOHN  Data storage systems technology for the Space Station	DEMEIS, RICHARD Mir - A second Sputnik? p 153 A87-46872
CREAMER, NELSON G.  An identification method for flexible structures	era	DEMING, DOUGLAS R.
[AIAA PAPER 87-0745] p 16 A87-33669	[AIAA PAPER 87-2202] p 113 A87-48587	Rendezyous and docking tracker
CREMA LIUGI RALIS	Mass storage systems for data transport in the early	[AAS PAPER 86-014] p 133 A87-32733
Effect of modal damping in modal synthesis of spacecraft structures p 26 N87-20362	space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443	DER, JAMES J.
structures p 26 1467-20302  CRESDEE, M. T.	DANIEL, P. L.	Liquid propellant tank ullage bubble deformation and breakup in low gravity reorientation
The use of electric propulsion on low earth orbit	A spline-based parameter and state estimation	[AIAA PAPER 87-2021] p 92 A87-45360
spacecraft	technique for static models of elastic surfaces	DERBY, EDDY A.
[AIAA PAPER 87-0989] p 88 A87-38003 CRISWELL, DAVID R.	[NASA-CR-180449] p 11 N87-30107	Measuring thermal expansion in large composite
Planning for space robotics developments and	DARBHAMULLA, SIVA PRASAD Substructure analysis using NICE/SPAR and	
applications p 135 A87-40377	applications of force to linear and nonlinear structures	DERBYSHIRE, KEITH Enhancement of solar absorptance degradation due to
CROLEY, D.	[NASA-CR-180317] p 38 N87-27260	contamination of solar radiator panels in geosynchronous
Potential modulation on the SCATHA spacecraft p 138 A87-34460	DARMS, FRED J.	orbit - Correlation of flight data and laboratory
CROLEY, D. R., JR.	Composite fiber/metal Space Station tankage - Applications, material/process/design trades, and	measurements p 144 A87-32346
Potential modulations on SCATHA (Spacecraft Charging	subscale manufacturing/test results	DES JARDINS, R.  Data management standards for space information
At High Altitude) spacecraft [AD-A176815] p 140 N87-21024	[AIAA PAPER 87-2157] p 160 A87-45441	systems
[AD-A176815] p 140 N87-21024 CROOP, HAROLD C.	DAROOKA, D. K.	[ÁIAA PAPER 87-2205] p 113 A87-48590
Development of precision structural joints for large space	A transient analysis of phase change energy storage	DETTLAFF, K.
structures p 28 N87-20374	system for solar dynamic power [AIAA PAPER 87-1469] p 77 A87-43004	Aerospatiale solar arrays, in orbit performance p 159 N87-28988
CROSS, J. B.  High intensity 5 eV CW laser sustained 0-atom exposure	DAVIES, D. K.	DEVANCE, DARRELL
facility for material degradation studies	Radiation charging and breakdown of insulators	Space station power semiconductor package
p 105 A87-32060	p 143 N87-26954	[NASA-CR-180829] p 81 N87-28825
Mass spectrometers and atomic oxygen p 141 N87-26176	DAVIES, JOHN K. Infra-red astronomy after IRAS p 127 A87-54197	DEVER, TERESE  An evaluation of candidate oxidation resistant
High intensity 5 eV atomic oxygen source and Low Earth	DAVIS I. P.	materials p 110 N87-26203
Orbit (LEO) simulation facility p 141 N87-26186	Workshop on Structural Dynamics and Control	DEVER. THERESE
CUCCIA C LOUIS	Interaction of Flexible Structures p 32 N87-22728	An evaluation of candidate oxidation resistant materials
The evolution of the geostationary platform concept p 125 A87-43154	DAVIS, M. H.  Upper and Middle Atmospheric Density Modeling	for space applications in LEO [NASA-TM-100122] p 107 N87-25480
CUDDIHY, W. F.	Requirements for Spacecraft Design and Operations	[NASA-TM-100122] p 107 N87-25480 DEVILLIERS. D.
An advanced technology space station for the year 2025,	[NASA-CP-2460] p 64 N87-20665	The orbit configuration panel report
study and concepts	DAVIS, ROBERT A.  Technology projections and space systems	p 157 N87-20640
[NASA-CR-178208] p 120 N87-20340	opportunities for the 2000-2030 time period	DEVILLIERS, N.
CULP, ROBERT D.  Guidance and control 1986; Proceedings of the Annual	[AAS PAPER 86-109] p 2 A87-53086	Working group on Earth observation requirements for the Polar Orbiting Platform Elements of the International
Rocky Mountain Guidance and Control Conference,	DAVIS, V. A.	Space Station (the POPE Working Group)
Keystone, CO, Feb. 1-5, 1986 p 55 A87-32726	Ram ion scattering caused by Space Shuttle v x B induced differential charging p 140 A87-51713	p 128 N87-20625
CURRAN 9 J	DE LUCA, LUIGI	Orbit configurations p 156 N87-20629
A polar platform for the remote sensing needs of ecology	The tethered satellite system for low density	DIARRA, CHEICK M.
and agriculture - A view from the U.K. p 125 A87-41430	aerothermodynamics studies p 127 A87-52450	The dynamics and control of large flexible space structures X, part 1
CURTIC PORFRT I	DEACETIS, LOUIS A.  Development of a computer program to generate typical	[NASA-CR-181287] p 73 N87-27712
Habitability issues for the Science Laboratory Module	measurement values for various systems on a space	DIETZ. REINHOLD H.
[SAE PAPER 860971] p 50 A87-38753	station p 115 N87-26698	Space Station communications and tracking system
CURTIS, S. B.  Radiation environments and absorbed dose estimations	DEAN, D. J.  The Vanderbilt University neutral O-beam facility	p 134 A87-37297
on manned space missions p 139 A87-49026	p 105 A87-32059	DIFILIPPO, FRANK  An evaluation of candidate oxidation resistant materials
CURTIC SALLY	DEBROCK, S. C.	for space applications in LEO
Characterization and hardware modification of linear	On-orbit assembly and repair p 135 A87-40376	[NASA-TM-100122] p 107 N87-25480
momentum exchange devices	DECARLIS, JAMES J., JR.  Energy expenditure during simulated EVA workloads	An evaluation of candidate oxidation resistant
[NASA-TM-86594] p 70 N67-24725 CUSICK, ROBERT J.		materials p 110 N87-26203
	[SAE PAPER 860921] p 163 A87-38713	
An advanced carbon reactor subsystem for carbon	DEFELICE, DAVID M.	DIPIRRO, MICHAEL J. Superfluid belium on orbit transfer (SHOOT)
An advanced carbon reactor subsystem for carbon dioxide reduction	DEFELICE, DAVID M.  Thermodynamic analysis and subscale modeling of	DIPIRRO, MICHAEL J.  Superfluid helium on orbit transfer (SHOOT)  p 95 N87-21151
An advanced carbon reactor subsystem for carbon dioxide reduction [SAE PAPER 860995] p 51 A87-38772	DEFELICE, DAVID M.  Thermodynamic analysis and subscale modeling of space-based orbit transfer vehicle cryogenic propellant	Superfluid helium on orbit transfer (SHOOT) p 95 N87-21151 DOANE, G. B., III
An advanced carbon reactor subsystem for carbon dioxide reduction [SAE PAPER 860995] p 51 A87-38772	DEFELICE, DAVID M.  Thermodynamic analysis and subscale modeling of space-based orbit transfer vehicle cryogenic propellant resupply  [AIAA PAPER 87-1764]  D 92 A87-48572	Superfluid helium on orbit transfer (SHOOT) p 95 N87-21151  DOANE, G. B., III Distributed control using linear momentum exchange
An advanced carbon reactor subsystem for carbon dioxide reduction [SAE PAPER 860995] p 51 A87-38772	DEFELICE, DAVID M.  Thermodynamic analysis and subscale modeling of space-based orbit transfer vehicle cryogenic propellant resupply	Superfluid helium on orbit transfer (SHOOT) p 95 N87-21151 DOANE, G. B., III

CVETANOVIC, R. J.

DOBLAS, F.	Water recycling for Space Station p 46 A87-32459	ERICKSON, ALBERT C.
Service Manipulator Arm (SMA) for a Robotic Servicing Experiment (ROSE)	EBERHARDT, RALPH N. On-orbit fluid management p 132 A87-32543	Space Station life support oxygen generation by SPI water electrolyzer systems
[ESA-CR(P)-2347] p 103 N87-28260	ECK, T. G.	[SAE PAPER 860949] p 49 A87-3873
DOLKAS, PAUL C.	Oxygen interaction with space-power materials	ERICKSON, C. M.
Special considerations in outfitting a space station	[NASA-CR-181396] p 132 N87-29633	Concepts for space maintenance of OTV engines
module for scientific use	ECKARDT, THOMAS	p 135 A87-4116
[SAE PAPER 860956] p 164 A87-38741	Preliminary analysis of a prototype space solar power	Concepts for space maintenance of OTV engines
DONATO, MARC	system	p 136 A87-4600
Evaluation of the infrared test method for the Olympus	[ILR-MITT-168] p 79 N87-24532	Concepts for space maintenance of OTV engines
thermal balance tests p 44 A87-46682	ECKHARDT, K.	p 137 N87-2609
DONCHIN, EMANUEL	Development of experimental/analytical concepts for structural design verification	ERICKSON, JON D.
Workshop on Workload and Training, and Examination	[ESA-CR(P)-2340] p 36 N87-26075	Manned spacecraft automation and robotics
of their Interactions: Executive summary	EDBERG, D. L.	p 100 A87-3730
[NASA-TM-89459] p 171 N87-25760	On the control of flexible structures by applied thermal	ERWIN, HARRY O.
DONG, EDWARD V. On board Data Management p 112 A87-40381	gradients	Laser docking system flight experiment
On board Data Management p 112 A87-40381  DONOHOE, MARTIN J.	[AIAA PAPER 87-0887] p 16 A87-33706	[AAS PAPER 86-043] p 99 A87-32749 ESHUIS. D.
Earth resources instrumentation for the Space Station	EDBERG, DON	Survey of solar-dynamic space power - The Stirling
Polar Platform p 126 A87-44184	On the control of structures by applied thermal	option p 77 A87-4226
DORR, LES, JR.	gradients p 33 N87-22747	ESTES, JOHN E.
When the doctor is 200 miles away	EDBERG, DONALD L.	Remote Sensing Information Sciences Research Group
p 47 A87-35600	Control of flexible structures by applied thermal	Santa Barbara Information Sciences Research Group, yea
DOUGHERTY, H. J.	gradients p 21 A87-39543	4
Vibration isolation for line of sight performance	EDELSON, BURTON I.	[NASA-CR-181073] p 115 N87-24817
improvement p 67 N87-22742	The evolution of the geostationary platform concept p 125 A87-43154	ESTES, ROBERT D.
DOURA, T.	EDELSTEIN, FRED	Investigation of plasma contactors for use with orbiting
Japanese data relay satellite system	Thermal test results of the two-phase thermal bus	wires
[AlAA PAPER 87-2199] p 154 A87-48585 DOW. JOHN O.	technology demonstration loop	[NASA-CR-180922] p 129 N87-22509
	[AIAA PAPER 87-1627] p 44 A87-43125	Investigation of plasma contactors for use with orbiting
An equivalent continuum analysis procedure for Space Station lattice structures	EDGEMON, GEORGE D.	Wires
[AIAA PAPER 87-0724] p 13 A87-33564	Characterization and hardware modification of linear	[NASA-CR-181422] p 131 N87-2959 <sup>-</sup> EVANGELIDES, J. S.
DRAISEY, S.	momentum exchange devices	Effects on advanced materials: Results of the STS-8
Modal testing of the Olympus development model	[NASA-TM-86594] p 70 N87-24723	EOIM (Effects of Oxygen Interaction with Materials
stowed solar array p 27 N87-20366	EDIGHOFFER, HAROLD H.	experiment
DREER, THOMAS	Quasi-static shape adjustment of a 15 meter diameter	[AD-A182931] p 110 N87-29709
Preliminary analysis of a prototype space solar power	space antenna	EVERMAN, M. R.
system	[AIAA PAPER 87-0869] p 15 A87-33633 Dynamic analysis and experiment methods for a generic	Preliminary design, analysis, and costing of a dynamic
[ILR-MITT-168] p 79 N87-24532	space station model p 22 A87-41613	scale model of the NASA space station
DUCHOSSOIS, G.	Dynamic and thermal response finite element models	[NASA-CR-4068] p 36 N87-25606
USA-Europe coordination and cooperation activities:	of multi-body space structural configurations	EVERMAN, MICHAEL R.
Announcements of Opportunity p 170 N87-20632 Panel report on multidisciplinary instrumentation: New	[NASA-CR-178289] p 10 N87-24709	Space Station alpha joint bearing p 83 N87-29882
possibilities p 161 N87-20637	EGRY, I.	EWELL, R.
DUCK, M. J.	Scientific user requirements for microgravity research	Nuclear reactor power for an electrically powered orbita transfer vehicle
Surface modification to minimise the electrostatic	(European aspects)	[AIAA PAPER 87-1102] p 76 A87-41145
charging of Kapton in the space environment	[AIAA PAPER 87-2195] p 153 A87-48581	EWELL, RICHARD
p 87 N87-26959	EGUCHI, IWAO	Nuclear reactor power for a space-based radar. SP-100
		project
DUFRANÉ, KEITH	Japanese experiment module data management and	project
Space Station lubrication considerations	communication system p 147 A87-32542	[NASA-TM-89295] p 79 N87-25838
Space Station lubrication considerations p 104 N87-29879	communication system p 147 A87-32542 EIKE, DAVID	
Space Station lubrication considerations p 104 N87-29879 <b>DUNN, KEVIN W.</b>	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows	[NASA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W. Space station data management system - A common	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161	[NÁSA-TM-89295] p 79 N87-25836 EZAWA, NAOYA
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W. Space station data management system - A common GSE test interface for systems testing and verification	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.	[NÁSA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050	[NASA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W. Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M.	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O.	[NÁSA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R. User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O. On the inadequacies of current multi-flexible body	[NÁSA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W. Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M. The multi-disciplinary design study. A life cycle cost	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R. User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O. On the inadequacies of current multi-flexible body simulation codes	[NÁSA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W. Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M. The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T.	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R. User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O. On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412	[NÁSA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W. Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M. The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T. The definition of the low earth orbital environment and	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O.  On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C.	[NÁSA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M.  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T.  The definition of the low earth orbital environment and its effect on thermal control materials	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R. User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O. On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C. Common drive unit p 104 N87-29869	[NÁSA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W. Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M. The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T. The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O. On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C. Common drive unit p 104 N87-29869  ELZEKI, M.	[NÁSA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579  FAGOT, CATHERINE
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W. Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M. The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T. The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103  DUROCHER, CORT L.	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R. User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O. On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C. Common drive unit p 104 N87-29869	[NÁSA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579  FAGOT, CATHERINE  Physiological requirements and pressure control of a
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M.  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T.  The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103  DUROCHER, CORT L  National space transportation studies	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O.  On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C.  Common drive unit p 104 N87-29869  ELZEKI, M.  Modal testing of the Olympus development model	[NÁSA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579  FAGOT, CATHERINE
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W. Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M. The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T. The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103  DUROCHER, CORT L.	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O. On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C. Common drive unit p 104 N87-29869  ELZEKI, M.  Modal testing of the Olympus development model stowed solar array p 27 N87-20366  EMANUEL, ERVIN M. Space station electrical power distribution analysis using	[NÁSA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579  FAGOT, CATHERINE  Physiological requirements and pressure control of a spaceplane
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M.  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T.  The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103  DURCHER, CORT L.  National space transportation studies [SAE PAPER 861681] p 160 A87-32598	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R. User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O. On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C. Common drive unit p 104 N87-29869  ELZEKI, M. Modal testing of the Olympus development model stowed solar array p 27 N87-20366  EMANUEL, ERVIN M. Space station electrical power distribution analysis using a load flow approach p 80 N87-26699	[NÁSA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579  FAGOT, CATHERINE  Physiological requirements and pressure control of a spaceplane  [SAE PAPER 860965] p 150 A87-38747
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M.  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T.  The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103  DURCHER, CORT L.  National space transportation studies [SAE PAPER 861681] p 160 A87-32598  DURRETT, JOHN C.  Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference,	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O.  On the inadequacies of current multi-flexible body simulation codes  [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C.  Common drive unit p 104 N87-29869  ELZEKI, M.  Modal testing of the Olympus development model stowed solar array p 27 N87-20366  EMANUEL, ERVIN M.  Space station electrical power distribution analysis using a load flow approach p 80 N87-26699  EMERY, A. F.	[NÁSA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579  FAGOT, CATHERINE  Physiological requirements and pressure control of a spaceplane  [SAE PAPER 860965] p 150 A87-38747  FANSON, J. L.  Positive position feedback control for large space structures
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M.  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T.  The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103  DUROCHER, CORT L.  National space transportation studies [SAE PAPER 861681] p 160 A87-32598  DURRETT, JOHN C.  Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 p 55 A87-32726	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O.  On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C.  Common drive unit p 104 N87-29869  ELZEKI, M.  Modal testing of the Olympus development model stowed solar array p 27 N87-20366  EMANUEL, ERVIN M.  Space station electrical power distribution analysis using a load flow approach p 80 N87-26699  EMERY, A. F.  Radiation heat transfer calculations for space	[NÁSA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579  FAGOT, CATHERINE  Physiological requirements and pressure control of a spaceplane  [SAE PAPER 860965] p 150 A87-38747  FANSON, J. L.  Positive position feedback control for large space structures  [AIAA PAPER 87-0902] p 17 A87-33711
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M.  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T.  The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103  DUROCHER, CORT L  National space transportation studies [SAE PAPER 861681] p 160 A87-32598  DURRETT, JOHN C.  Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 p 55 A87-32726	communication system p 147 A87-32542  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O.  On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C.  Common drive unit p 104 N87-29869  ELZEKI, M.  Modal testing of the Olympus development model stowed solar array p 27 N87-20366  EMANUEL, ERVIN M.  Space station electrical power distribution analysis using a load flow approach p 80 N87-26699  EMERY, A. F.  Radiation heat transfer calculations for space structures	[NASA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579  FAGOT, CATHERINE Physiological requirements and pressure control of a spaceplane [SAE PAPER 860965] p 150 A87-38747  FANSON, J. L.  Positive position feedback control for large space structures [AIAA PAPER 87-0902] p 17 A87-33711  Structural control by the use of piezoelectric active
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M.  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T.  The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103  DURCHER, CORT L.  National space transportation studies [SAE PAPER 861681] p 160 A87-32598  DURRETT, JOHN C. Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 p 55 A87-32726  DUSKE, N. Study on investigation of the attitude control of large	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O.  On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C.  Common drive unit p 104 N87-29869  ELZEKI, M.  Modal testing of the Olympus development model stowed solar array p 27 N87-20366  EMANUEL, ERVIN M.  Space station electrical power distribution analysis using a load flow approach p 80 N87-26699  EMERY, A. F.  Radiation heat transfer calculations for space structures  [AIAA PAPER 87-1522] p 44 A87-44830	[NÁSA-TM-89295] p 79 N87-25838  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579  FAGOT, CATHERINE  Physiological requirements and pressure control of a spaceplane  [SAE PAPER 860965] p 150 A87-38747  FANSON, J. L.  Positive position feedback control for large space structures  [AIAA PAPER 87-0902] p 17 A87-33711  Structural control by the use of piezoelectric active members p 69 N87-24509
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M.  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T.  The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103  DUROCHER, CORT L.  National space transportation studies [SAE PAPER 861681] p 160 A87-32598  DURRETT, JOHN C.  Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 p 55 A87-32726  DUSKE, N.  Study on investigation of the attitude control of large flexible spacecraft. Phase 2, volume 1: Executive	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O.  On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C.  Common drive unit p 104 N87-29869  ELZEKI, M.  Modal testing of the Olympus development model stowed solar array p 27 N87-20366  EMANUEL, ERVIN M.  Space station electrical power distribution analysis using a load flow approach p 80 N87-26699  EMERY, A. F.  Radiation heat transfer calculations for space structures [AIAA PAPER 87-1522] p 44 A87-44830  ENDRES, N. M.	[NÁSA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579  FAGOT, CATHERINE  Physiological requirements and pressure control of a spaceplane  [SAE PAPER 860965] p 150 A87-38747  FANSON, J. L.  Positive position feedback control for large space structures  [AIAA PAPER 87-0902] p 17 A87-33711  Structural control by the use of piezoelectric active members p 69 N87-24509
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M.  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T.  The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103  DUROCHER, CORT L.  National space transportation studies [SAE PAPER 861881] p 160 A87-32598  DURETT, JOHN C.  Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 p 55 A87-32726  DUSKE, N.  Study on investigation of the attitude control of large flexible spacecraft. Phase 2, volume 1: Executive summary	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O. On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C. Common drive unit p 104 N87-29869  ELZEKI, M. Modal testing of the Olympus development model stowed solar array p 27 N87-20366  EMANUEL, ERVIN M. Space station electrical power distribution analysis using a load flow approach p 80 N87-26699  EMERY, A. F. Radiation heat transfer calculations for space structures [AIAA PAPER 87-1522] p 44 A87-44830  ENDRES, N. M. Composite space antenna structures - Properties and	[NASA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579  FAGGT, CATHERINE  Physiological requirements and pressure control of a spaceplane  [SAE PAPER 860965] p 150 A87-38747  FANSON, J. L.  Positive position feedback control for large space structures  [AIAA PAPER 87-0902] p 17 A87-33711  Structural control by the use of piezoelectric active members p 69 N87-24509  FANSON, JAMES  Vibration suppression by stiffness control
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M.  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T.  The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103  DURCHER, CORT L.  National space transportation studies [SAE PAPER 861681] p 160 A87-32598  DURRETT, JOHN C. Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 p 55 A87-32726  DUSKE, N.  Study on investigation of the attitude control of large flexible spacecraft. Phase 2, volume 1: Executive summary [ESA-CR(P)-2361-VOL-1] p 73 N87-27707	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O.  On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C.  Common drive unit p 104 N87-29869  ELZEKI, M.  Modal testing of the Olympus development model stowed solar array p 27 N87-20366  EMANUEL, ERVIN M.  Space station electrical power distribution analysis using a load flow approach p 80 N87-26699  EMERY, A. F.  Radiation heat transfer calculations for space structures  [AIAA PAPER 87-1522] p 44 A87-44830  ENDRES, N. M.  Composite space antenna structures - Properties and environmental effects p 20 A87-38610	[NÁSA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579  FAGOT, CATHERINE  Physiological requirements and pressure control of a spaceplane  [SAE PAPER 860965] p 150 A87-38747  FANSON, J. L.  Positive position feedback control for large space structures  [AIAA PAPER 87-0902] p 17 A87-33711  Structural control by the use of piezoelectric active members p 69 N87-24509  FANSON, JAMES  Vibration suppression by stiffness control
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M.  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T.  The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103  DUROCHER, CORT L.  National space transportation studies [SAE PAPER 861881] p 160 A87-32598  DURETT, JOHN C.  Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 p 55 A87-32726  DUSKE, N.  Study on investigation of the attitude control of large flexible spacecraft. Phase 2, volume 1: Executive summary	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O.  On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C.  Common drive unit p 104 N87-29869  ELZEKI, M.  Modal testing of the Olympus development model stowed solar array p 27 N87-20366  EMANUEL, ERVIN M.  Space station electrical power distribution analysis using a load flow approach p 80 N87-26699  EMERY, A. F.  Radiation heat transfer calculations for space structures [AIAA PAPER 87-1522] p 44 A87-44830  ENDRES, N. M.  Composite space antenna structures - Properties and environmental effects p 20 A87-38610  ENGEL, ALBERT G.	[NASA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579  FAGGT, CATHERINE  Physiological requirements and pressure control of a spaceplane  [SAE PAPER 860965] p 150 A87-38747  FANSON, J. L.  Positive position feedback control for large space structures  [AIAA PAPER 87-0902] p 17 A87-33711  Structural control by the use of piezoelectric active members p 69 N87-24509  FANSON, JAMES  Vibration suppression by stiffness control
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M.  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T.  The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103  DURCHER, CORT L.  National space transportation studies [SAE PAPER 861681] p 160 A87-32598  DURRETT, JOHN C. Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 p 55 A87-32726  DUSKE, N.  Study on investigation of the attitude control of large flexible spacecraft. Phase 2, volume 1: Executive summary [ESA-CR(P)-2361-VOL-1] p 73 N87-27707  Study on investigation of the attitude control of large flexible spacecraft, phase 3 [ESA-CR(P)-2361-VOL-4] p 73 N87-27709	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O. On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C. Common drive unit p 104 N87-29869  ELZEKI, M. Modal testing of the Olympus development model stowed solar array p 27 N87-20366  EMANUEL, ERVIN M. Space station electrical power distribution analysis using a load flow approach p 80 N87-26699  EMERY, A. F. Radiation heat transfer calculations for space structures [AIAA PAPER 87-1522] p 44 A87-44830  ENDRES, N. M. Composite space antenna structures - Properties and environmental effects p 20 A87-38610  ENGEL, ALBERT G. Aeroassist flight experiment guidance, navigation and	[NÁSA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579  FAGOT, CATHERINE  Physiological requirements and pressure control of a spaceplane  [SAE PAPER 860965] p 150 A87-38747  FANSON, J. L.  Positive position feedback control for large space structures  [AIAP PAPER 87-0902] p 17 A87-33711  Structural control by the use of piezoelectric active members p 69 N87-24509  FANSON, JAMES  Vibration suppression by stiffness control p 66 N87-22730  FANSON, JAMES L.
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M.  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T.  The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103  DUROCHER, CORT L.  National space transportation studies [SAE PAPER 861681] p 160 A87-32598  DURRETT, JOHN C.  Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 p 55 A87-32726  DUSKE, N.  Study on investigation of the attitude control of large flexible spacecraft. Phase 2, volume 1: Executive summary [ESA-CR(P)-2361-VOL-1] p 73 N87-27707  Study on investigation of the attitude control of large flexible spacecraft, phase 3 [ESA-CR(P)-2361-VOL-4] p 73 N87-27709  DWYER, THOMAS A. W., III	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O.  On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C.  Common drive unit p 104 N87-29869  ELZEKI, M.  Modal testing of the Olympus development model stowed solar array p 27 N87-20366  EMANUEL, ERVIN M.  Space station electrical power distribution analysis using a load flow approach p 80 N87-26699  EMERY, A. F.  Radiation heat transfer calculations for space structures  [AIAA PAPER 87-1522] p 44 A87-44830  ENDRES, N. M.  Composite space antenna structures - Properties and environmental effects p 20 A87-38610  ENGEL, ALBERT G.  Aeroassist flight experiment guidance, navigation and control	[NÁSA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579  FAGOT, CATHERINE  Physiological requirements and pressure control of a spaceplane  [SAE PAPER 860965] p 150 A87-38747  FANSON, J. L.  Positive position feedback control for large space structures  [AIAP PAPER 87-0902] p 17 A87-33711  Structural control by the use of piezoelectric active members p 69 N87-24509  FANSON, JAMES  Vibration suppression by stiffness control p 66 N87-22730  FANSON, JAMES L.  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M.  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T.  The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103  DUROCHER, CORT L.  National space transportation studies [SAE PAPER 861881] p 160 A87-32598  DURCHER, JOHN C.  Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 p 55 A87-32726  DUSKE, N.  Study on investigation of the attitude control of large flexible spacecraft. Phase 2, volume 1: Executive summary  [ESA-CR(P)-2361-VOL-1] p 73 N87-27707  Study on investigation of the attitude control of large flexible spacecraft, phase 3  [ESA-CR(P)-2361-VOL-4] p 73 N87-27709  DWYER, THOMAS A. W., III  Variable structure controller design for spacecraft	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O.  On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C.  Common drive unit p 104 N87-29869  ELZEKI, M.  Modal testing of the Olympus development model stowed solar array p 27 N87-20366  EMANUEL, ERVIN M.  Space station electrical power distribution analysis using a load flow approach p 80 N87-26699  EMERY, A. F.  Radiation heat transfer calculations for space structures [AIAA PAPER 87-1522] p 44 A87-44830  ENDRES, N. M.  Composite space antenna structures - Properties and environmental effects p 20 A87-38610  ENGEL, ALBERT G.  Aeroassist flight experiment guidance, navigation and control [AAS PAPER 86-042] p 133 A87-32744	[NÁSA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030 FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579 FAGOT, CATHERINE Physiological requirements and pressure control of a spaceplane [SAE PAPER 860965] p 150 A87-38747 FANSON, J. L.  Positive position feedback control for large space structures [AIAA PAPER 87-0902] p 17 A87-33711 Structural control by the use of piezoelectric active members p 69 N87-24509 FANSON, JAMES Vibration suppression by stiffness control p 66 N87-22730 FANSON, JAMES L.  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937 FARADAY, BRUCE J.
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M.  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T.  The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103  DUROCHER, CORT L.  National space transportation studies [SAE PAPER 861681] p 160 A87-32598  DURRETT, JOHN C. Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 p 55 A87-32726  DUSKE, N.  Study on investigation of the attitude control of large flexible spacecraft. Phase 2, volume 1: Executive summary [ESA-CR(P)-2361-VOL-1] p 73 N87-27707  Study on investigation of the attitude control of large flexible spacecraft, phase 3 [ESA-CR(P)-2361-VOL-4] p 73 N87-27709  DWYER, THOMAS A. W., III  Variable structure controller design for spacecraft nutation damping p 58 A87-39958	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O.  On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C.  Common drive unit p 104 N87-29869  ELZEKI, M.  Modal testing of the Olympus development model stowed solar array p 27 N87-20366  EMANUEL, ERVIN M.  Space station electrical power distribution analysis using a load flow approach p 80 N87-26699  EMERY, A. F.  Radiation heat transfer calculations for space structures  [AIAA PAPER 87-1522] p 44 A87-44830  ENDRES, N. M.  Composite space antenna structures - Properties and environmental effects p 20 A87-38610  ENGEL, ALBERT G.  Aeroassist flight experiment guidance, navigation and control	[NASA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579  FAGOT, CATHERINE Physiological requirements and pressure control of a spaceplane [SAE PAPER 860965] p 150 A87-38747  FANSON, J. L.  Positive position feedback control for large space structures [AIAA PAPER 87-0902] p 17 A87-33711  Structural control by the use of piezoelectric active members p 69 N87-24509  FANSON, JAMES L.  An experimental investigation of vibration suppression in large space structures using positive position feedback  FARADAY, BRUCE J.  Testing of materials for solar power space
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M.  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T.  The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103  DURCHER, CORT L.  National space transportation studies [SAE PAPER 861681] p 160 A87-32598  DURRETT, JOHN C. Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 p 55 A87-32726  DUSKE, N.  Study on investigation of the attitude control of large flexible spacecraft. Phase 2, volume 1: Executive summary [ESA-CR(P)-2361-VOL-1] p 73 N87-27707  Study on investigation of the attitude control of large flexible spacecraft, phase 3 [ESA-CR(P)-2361-VOL-4] p 73 N87-27709  DWYER, THOMAS A. W., III  Variable structure controller design for spacecraft nutation damping p 58 A87-39958 Tracking and pointing maneuvers with slew-excited	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O.  On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C.  Common drive unit p 104 N87-29869  ELZEKI, M.  Modal testing of the Olympus development model stowed solar array p 27 N87-20366  EMANUEL, ERVIN M.  Space station electrical power distribution analysis using a load flow approach p 80 N87-26699  EMERY, A. F.  Radiation heat transfer calculations for space structures [AIAA PAPER 87-1522] p 44 A87-44830  ENDRES, N. M.  Composite space antenna structures - Properties and environmental effects p 20 A87-38610  ENGEL, ALBERT G.  Aeroassist flight experiment guidance, navigation and control [AAS PAPER 86-042] p 133 A87-32744  ENGELS, REMI C.	[NÁSA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579  FAGOT, CATHERINE  Physiological requirements and pressure control of a spaceplane  [SAE PAPER 860965] p 150 A87-38747  FANSON, J. L.  Positive position feedback control for large space structures  [AIAA PAPER 87-0902] p 17 A87-33711  Structural control by the use of piezoelectric active members p 69 N87-24509  FANSON, JAMES  Vibration suppression by stiffness control p 66 N87-22730  FANSON, JAMES L.  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937  FARADAY, BRUCE J.  Testing of materials for solar power space applications
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M.  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T.  The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103  DUROCHER, CORT L.  National space transportation studies [SAE PAPER 861881] p 160 A87-32598  DURCHER, JOHN C.  Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 p 55 A87-32726  DUSKE, N.  Study on investigation of the attitude control of large flexible spacecraft. Phase 2, volume 1: Executive summary [ESA-CR(P)-2361-VOL-1] p 73 N87-27707  Study on investigation of the attitude control of large flexible spacecraft, phase 3 [ESA-CR(P)-2361-VOL-4] p 73 N87-27709  DWYER, THOMAS A. W., III  Variable structure controller design for spacecraft nutation damping p 58 A87-39958  Tracking and pointing maneuvers with slew-excited deformation shaping	communication system p 147 A87-32542  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O.  On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C.  Common drive unit p 104 N87-29869  ELZEKI, M.  Modal testing of the Olympus development model stowed solar array p 27 N87-20366  EMANUEL, ERVIN M.  Space station electrical power distribution analysis using a load flow approach p 80 N87-26699  EMERY, A. F.  Radiation heat transfer calculations for space structures [AIAA PAPER 87-1522] p 44 A87-44830  ENDRES, N. M.  Composite space antenna structures - Properties and environmental effects p 20 A87-38610  ENGEL, ALBERT G.  Aeroassist flight experiment guidance, navigation and control [AAS PAPER 86-042] p 133 A87-32744  ENGELS, REMI C.  A general method for dynamic analysis of structures	[NASA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579  FAGOT, CATHERINE  Physiological requirements and pressure control of a spaceplane  [SAE PAPER 860965] p 150 A87-38747  FANSON, J. L.  Positive position feedback control for large space structures  [AIAA PAPER 87-0902] p 17 A87-33711  Structural control by the use of piezoelectric active members p 69 N87-24509  FANSON, JAMES  Vibration suppression by stiffness control p 66 N87-22730  FANSON, JAMES L.  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937  FARADAY, BRUCE J.  Testing of materials for solar power space applications p 197 A87-53946
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M.  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T.  The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103  DURCHER, CORT L.  National space transportation studies [SAE PAPER 861681] p 160 A87-32598  DURRETT, JOHN C. Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 p 55 A87-32726  DUSKE, N.  Study on investigation of the attitude control of large flexible spacecraft. Phase 2, volume 1: Executive summary [ESA-CR(P)-2361-VOL-1] p 73 N87-27707  Study on investigation of the attitude control of large flexible spacecraft, phase 3 [ESA-CR(P)-2361-VOL-4] p 73 N87-27709  DWYER, THOMAS A. W., III  Variable structure controller design for spacecraft nutation damping p 58 A87-39958 Tracking and pointing maneuvers with slew-excited	communication system p 147 A87-32542  EIKE, DAVID R.  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O.  On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C.  Common drive unit p 104 N87-29869  ELZEKI, M.  Modal testing of the Olympus development model stowed solar array p 27 N87-20366  EMANUEL, ERVIN M.  Space station electrical power distribution analysis using a load flow approach p 80 N87-26699  EMERY, A. F.  Radiation heat transfer calculations for space structures [AIAA PAPER 87-1522] p 44 A87-44830  ENDRES, N. M.  Composite space antenna structures - Properties and environmental effects p 20 A87-38610  ENGEL, ALBERT G.  Aeroassist flight experiment guidance, navigation and control [AAS PAPER 86-042] p 133 A87-32744  ENGELS, REMI C.  A general method for dynamic analysis of structures overview p 31 N87-22707  ENGLISH, ROBERT E.  Speculations on future opportunities to evolve Brayton	[NASA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579  FAGOT, CATHERINE Physiological requirements and pressure control of a spaceplane [SAE PAPER 860965] p 150 A87-38747  FANSON, J. L.  Positive position feedback control for large space structures [AIAA PAPER 87-0902] p 17 A87-33711  Structural control by the use of piezoelectric active members p 69 N87-24509  FANSON, JAMES L.  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937  FARADAY, BRUCE J.  Testing of materials for solar power space applications p 107 A87-53946  FARINA, F.  Organic Rankine cycle power conversion systems for
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M.  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T.  The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103  DUROCHER, CORT L.  National space transportation studies [SAE PAPER 861681] p 160 A87-32598  DURRETT, JOHN C. Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 p 55 A87-32726  DUSKE, N.  Study on investigation of the attitude control of large flexible spacecraft. Phase 2, volume 1: Executive summary [ESA-CR(P)-2361-VOL-1] p 73 N87-27707  Study on investigation of the attitude control of large flexible spacecraft, phase 3 [ESA-CR(P)-2361-VOL-4] p 73 N87-27709  DWYER, THOMAS A. W., III  Variable structure controller design for spacecraft nutation damping p 58 A87-39958 Tracking and pointing maneuvers with slew-excited deformation shaping [AIAA PAPER 87-2599] p 62 A87-50561	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O.  On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C.  Common drive unit p 104 N87-29869  ELZEKI, M.  Modal testing of the Olympus development model stowed solar array p 27 N87-20366  EMANUEL, ERVIN M.  Space station electrical power distribution analysis using a load flow approach p 80 N87-26699  EMERY, A. F.  Radiation heat transfer calculations for space structures  [AIAA PAPER 87-1522] p 44 A87-44830  ENDRES, N. M.  Composite space antenna structures - Properties and environmental effects p 20 A87-38610  ENGEL, ALBERT G.  Aeroassist flight experiment guidance, navigation and control [AAS PAPER 86-042] p 133 A87-32744  ENGELS, REMI C.  A general method for dynamic analysis of structures overview p 31 N87-22707  ENGLISH, ROBERT E.  Speculations on future opportunities to evolve Brayton powerplants aboard the space station	[NÁSA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579  FAGOT, CATHERINE  Physiological requirements and pressure control of a spaceplane  [SAE PAPER 860965] p 150 A87-38747  FANSON, J. L.  Positive position feedback control for large space structures  [AIAA PAPER 87-0902] p 17 A87-33711  Structural control by the use of piezoelectric active members p 69 N87-24509  FANSON, JAMES  Vibration suppression by stiffness control p 66 N87-22730  FANSON, JAMES L.  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937  FARADAY, BRUCE J.  Testing of materials for solar power space applications p 159 N87-28989  FARINA, F.  Organic Rankine cycle power conversion systems for space applications p 159 N87-28989
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M.  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T.  The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103  DUROCHER, CORT L.  National space transportation studies [SAE PAPER 861881] p 160 A87-32598  DURCHER, JOHN C.  Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 p 55 A87-32726  DUSKE, N.  Study on investigation of the attitude control of large flexible spacecraft. Phase 2, volume 1: Executive summary [ESA-CR(P)-2361-VOL-1] p 73 N87-27707  Study on investigation of the attitude control of large flexible spacecraft, phase 3 [ESA-CR(P)-2361-VOL-4] p 73 N87-27709  DWYER, THOMAS A. W., III  Variable structure controller design for spacecraft nutation damping p 58 A87-39958  Tracking and pointing maneuvers with slew-excited deformation shaping	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O.  On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C.  Common drive unit p 104 N87-29869  ELZEKI, M.  Modal testing of the Olympus development model stowed solar array p 27 N87-20366  EMANUEL, ERVIN M.  Space station electrical power distribution analysis using a load flow approach p 80 N87-26699  EMERY, A. F.  Radiation heat transfer calculations for space structures [AIAA PAPER 87-1522] p 44 A87-44830  ENDRES, N. M.  Composite space antenna structures - Properties and environmental effects p 20 A87-38610  ENGEL, ALBERT G.  Aeroassist flight experiment guidance, navigation and control [AAS PAPER 86-042] p 133 A87-32744  ENGELS, REMI C.  A general method for dynamic analysis of structures overview p 31 N87-22707  ENGLISH, ROBERT E.  Speculations on future opportunities to evolve Brayton powerplants aboard the space station [NASA-TM-89863] p 121 N87-23674	[NASA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579  FAGOT, CATHERINE  Physiological requirements and pressure control of a spaceplane  [SAE PAPER 860965] p 150 A87-38747  FANSON, J. L.  Positive position feedback control for large space structures  [AIAA PAPER 87-0902] p 17 A87-33711  Structural control by the use of piezoelectric active members p 69 N87-24509  FANSON, JAMES  Vibration suppression by stiffness control p 66 N87-22730  FANSON, JAMES L.  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937  FARADAY, BRUCE J.  Testing of materials for solar power space applications p 159 N87-28989  FARINA, F.  Organic Rankine cycle power conversion systems for space applications p 159 N87-28989  FARMER, JEFFERY T.
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M.  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T.  The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103  DUROCHER, CORT L.  National space transportation studies [SAE PAPER 861681] p 160 A87-32598  DURRETT, JOHN C.  Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 p 55 A87-32726  DUSKE, N.  Study on investigation of the attitude control of large flexible spacecraft. Phase 2, volume 1: Executive summary [ESA-CR(P)-2361-VOL-1] p 73 N87-27707  Study on investigation of the attitude control of large flexible spacecraft, phase 3 [ESA-CR(P)-2361-VOL-4] p 73 N87-27709  DWYER, THOMAS A. W., III  Variable structure controller design for spacecraft nutation damping p 58 A87-39958  Tracking and pointing maneuvers with slew-excited deformation shaping [AIAA PAPER 87-2599] p 62 A87-50561	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O.  On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C.  Common drive unit p 104 N87-29869  ELZEKI, M.  Modal testing of the Olympus development model stowed solar array p 27 N87-20366  EMANUEL, ERVIN M.  Space station electrical power distribution analysis using a load flow approach p 80 N87-26699  EMERY, A. F.  Radiation heat transfer calculations for space structures [AIAA PAPER 87-1522] p 44 A87-44830  ENDRES, N. M.  Composite space antenna structures - Properties and environmental effects p 20 A87-38610  ENGEL, ALBERT G.  Aeroassist flight experiment guidance, navigation and control [AAS PAPER 86-042] p 133 A87-32744  ENGELS, REMI C.  A general method for dynamic analysis of structures overview p 31 N87-22707  ENGLISH, ROBERT E.  Speculations on future opportunities to evolve Brayton powerplants aboard the space station [NASA-TM-99863] p 121 N87-23674	[NÁSA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579  FAGOT, CATHERINE  Physiological requirements and pressure control of a spaceplane  [SAE PAPER 860965] p 150 A87-38747  FANSON, J. L.  Positive position feedback control for large space structures  [AIAA PAPER 87-0902] p 17 A87-33711  Structural control by the use of piezoelectric active members p 69 N87-24509  FANSON, JAMES  Vibration suppression by stiffness control p 66 N87-22730  FANSON, JAMES L.  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937  FARADAY, BRUCE J.  Testing of materials for solar power space applications p 159 N87-28989  FARINA, F.  Organic Rankine cycle power conversion systems for space applications p 159 N87-28989
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M.  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T.  The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103  DUROCHER, CORT L.  National space transportation studies [SAE PAPER 861881] p 160 A87-32598  DURCHER, CORT L.  Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 p 55 A87-32726  DUSKE, N.  Study on investigation of the attitude control of large flexible spacecraft. Phase 2, volume 1: Executive summary [ESA-CR(P)-2361-VOL-4] p 73 N87-27707  Study on investigation of the attitude control of large flexible spacecraft, phase 3 [ESA-CR(P)-2361-VOL-4] p 73 N87-27709  DWYER, THOMAS A. W., III  Variable structure controller design for spacecraft nutation damping p 58 A87-39958  Tracking and pointing maneuvers with slew-excited deformation shaping [AIAA PAPER 87-2599] p 62 A87-50561	communication system p 147 A87-32542  EIKE, DAVID R.  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O.  On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C.  Common drive unit p 104 N87-29869  ELZEKI, M.  Modal testing of the Olympus development model stowed solar array p 27 N87-20366  EMANUEL, ERVIN M.  Space station electrical power distribution analysis using a load flow approach p 80 N87-26699  EMERY, A. F.  Radiation heat transfer calculations for space structures [AIAA PAPER 87-1522] p 44 A87-44830  ENDRES, N. M.  Composite space antenna structures - Properties and environmental effects p 20 A87-38610  ENGEL, ALBERT G.  Aeroassist flight experiment guidance, navigation and control [AAS PAPER 86-042] p 133 A87-32744  ENGELS, REMI C.  A general method for dynamic analysis of structures overview p 31 N87-22707  ENGLISH, ROBERT E.  Speculations on future opportunities to evolve Brayton powerplants aboard the space station [NASA-TM-89863] p 121 N87-23674  ENNIX, KIMBERLY A.  Liquid propulsion technology for expendable and STS	[NASA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579  FAGOT, CATHERINE  Physiological requirements and pressure control of a spaceplane  [SAE PAPER 860965] p 150 A87-38747  FANSON, J. L.  Positive position feedback control for large space structures  [AIAA PAPER 87-0902] p 17 A87-33711  Structural control by the use of piezoelectric active members p 69 N87-24509  FANSON, JAMES  Vibration suppression by stiffness control p 66 N87-22730  FANSON, JAMES L.  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937  FARDAY, BRUCE J.  Testing of materials for solar power space applications p 159 N87-29898  FARINA, F.  Organic Rankine cycle power conversion systems for space applications p 159 N87-28989  FARMER, JEFFERY T.  Analysis of on-orbit thermal characteristics of the 15-meter hoop/column antennal [NASA-TM-89137] p 45 N87-21021
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M.  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T.  The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103  DUROCHER, CORT L.  National space transportation studies [SAE PAPER 861681] p 160 A87-32598  DURRETT, JOHN C. Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 p 55 A87-32726  DUSKE, N.  Study on investigation of the attitude control of large flexible spacecraft. Phase 2, volume 1: Executive summary [ESA-CR(P)-2361-VOL-1] p 73 N87-27707  Study on investigation of the attitude control of large flexible spacecraft, phase 3 [ESA-CR(P)-2361-VOL-4] p 73 N87-27709  DWYER, THOMAS A. W., III  Variable structure controller design for spacecraft nutation damping p 58 A87-39958  Tracking and pointing maneuvers with slew-excited deformation shaping [AIAA PAPER 87-2599] p 62 A87-50561	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O.  On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C.  Common drive unit p 104 N87-29869  ELZEKI, M.  Modal testing of the Olympus development model stowed solar array p 27 N87-20366  EMANUEL, ERVIN M.  Space station electrical power distribution analysis using a load flow approach p 80 N87-26699  EMERY, A. F.  Radiation heat transfer calculations for space structures  [AIAA PAPER 87-1522] p 44 A87-44830  ENDRES, N. M.  Composite space antenna structures - Properties and environmental effects p 20 A87-39610  ENGEL, ALBERT G.  Aeroassist flight experiment guidance, navigation and control  [AAS PAPER 86-042] p 133 A87-32744  ENGELS, REMI C.  A general method for dynamic analysis of structures overview p 31 N87-22707  ENGLISH, ROBERT E.  Speculations on future opportunities to evolve Brayton powerplants aboard the space station  [NASA-TM-89863] p 121 N87-23674  ENNIX, KIMBERLY A.  Liquid propulsion technology for expendable and STS launch vehicle transfer stages	[NASA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579  FAGOT, CATHERINE Physiological requirements and pressure control of a spaceplane [SAE PAPER 860965] p 150 A87-38747  FANSON, J. L.  Positive position feedback control for large space structures [AIAA PAPER 87-0902] p 17 A87-33711  Structural control by the use of piezoelectric active members p 69 N87-24509  FANSON, JAMES Vibration suppression by stiffness control p 66 N87-22730  FANSON, JAMES L.  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937  FARADAY, BRUCE J.  Testing of materials for solar power space applications p 159 N87-28989  FARRIA, JEFFERY T.  Analysis of on-orbit thermal characteristics of the 15-meter hoop/column antenna [NASA-TM-89137] p 45 N87-21021
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M.  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T.  The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103  DUROCHER, CORT L.  National space transportation studies [SAE PAPER 861681] p 160 A87-32598  DURRETT, JOHN C.  Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 p 55 A87-32726  DUSKE, N.  Study on investigation of the attitude control of large flexible spacecraft. Phase 2, volume 1: Executive summary [ESA-CR(P)-2361-VOL-1] p 73 N87-27707  Study on investigation of the attitude control of large flexible spacecraft, phase 3 [ESA-CR(P)-2361-VOL-4] p 73 N87-27709  DWYER, THOMAS A. W., III  Variable structure controller design for spacecraft nutation damping p 58 A87-39958  Tracking and pointing maneuvers with slew-excited deformation shaping [AIAA PAPER 87-2599] p 62 A87-50561	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O.  On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C.  Common drive unit p 104 N87-29869  ELZEKI, M.  Modal testing of the Olympus development model stowed solar array p 27 N87-20366  EMANUEL, ERVIN M.  Space station electrical power distribution analysis using a load flow approach p 80 N87-26699  EMERY, A. F.  Radiation heat transfer calculations for space structures [AIAA PAPER 87-1522] p 44 A87-44830  ENDRES, N. M.  Composite space antenna structures - Properties and environmental effects p 20 A87-38610  ENGEL, ALBERT G.  Aeroassist flight experiment guidance, navigation and control [AAS PAPER 86-042] p 133 A87-32744  ENGELS, REMI C.  A general method for dynamic analysis of structures overview p 31 N87-22707  ENGLISH, ROBERT E.  Speculations on future opportunities to evolve Brayton powerplants aboard the space station [NASA-TM-89863] p 121 N87-23674  ENNIX, KIMBERLY A.  Liquid propulsion technology for expendable and STS launch vehicle transfer stages [AIAA PAPER 87-1934] p 92 A87-45311	INÁSA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  F  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579  FAGOT, CATHERINE  Physiological requirements and pressure control of a spaceplane  [SAE PAPER 860965] p 150 A87-38747  FANSON, J. L.  Positive position feedback control for large space structures  [AIAA PAPER 87-0902] p 17 A87-33711  Structural control by the use of piezoelectric active members p 69 N87-24509  FANSON, JAMES  Vibration suppression by stiffness control p 66 N87-22730  FANSON, JAMES L.  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937  FARADAY, BRUCE J.  Testing of materials for solar power space applications p 159 N87-28937  FARINA, F.  Organic Rankine cycle power conversion systems for space applications p 159 N87-28989  FARMER, JEFFERY T.  Analysis of on-orbit thermal characteristics of the 15-meter hoop/column antenna [NASA-TM-89137]  FARRANCE, MICHELLE A.  Space Station - The next logical step
Space Station lubrication considerations p 104 N87-29879  DUNN, KEVIN W.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  DURAN, J. M.  The multi-disciplinary design study. A life cycle cost algorithm [NASA-CR-178192] p 9 N87-21995  DURCANIN, J. T.  The definition of the low earth orbital environment and its effect on thermal control materials [AIAA PAPER 87-1599] p 43 A87-43103  DUROCHER, CORT L.  National space transportation studies [SAE PAPER 861681] p 160 A87-32598  DURRETT, JOHN C. Guidance and control 1986; Proceedings of the Annual Rocky Mountain Guidance and Control Conference, Keystone, CO, Feb. 1-5, 1986 p 55 A87-32726  DUSKE, N.  Study on investigation of the attitude control of large flexible spacecraft. Phase 2, volume 1: Executive summary [ESA-CR(P)-2361-VOL-1] p 73 N87-27707  Study on investigation of the attitude control of large flexible spacecraft, phase 3 [ESA-CR(P)-2361-VOL-4] p 73 N87-27709  DWYER, THOMAS A. W., III  Variable structure controller design for spacecraft nutation damping p 58 A87-39958  Tracking and pointing maneuvers with slew-excited deformation shaping [AIAA PAPER 87-2599] p 62 A87-50561	communication system p 147 A87-32542  EIKE, DAVID  SOT: A rapid prototype using TAE windows p 114 N87-23161  EIKE, DAVID R.  User interface design guidelines for expert troubleshooting systems p 6 A87-33050  EKE, FIDELIS O.  On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412  ELLIS, R. C.  Common drive unit p 104 N87-29869  ELZEKI, M.  Modal testing of the Olympus development model stowed solar array p 27 N87-20366  EMANUEL, ERVIN M.  Space station electrical power distribution analysis using a load flow approach p 80 N87-26699  EMERY, A. F.  Radiation heat transfer calculations for space structures  [AIAA PAPER 87-1522] p 44 A87-44830  ENDRES, N. M.  Composite space antenna structures - Properties and environmental effects p 20 A87-39610  ENGEL, ALBERT G.  Aeroassist flight experiment guidance, navigation and control  [AAS PAPER 86-042] p 133 A87-32744  ENGELS, REMI C.  A general method for dynamic analysis of structures overview p 31 N87-22707  ENGLISH, ROBERT E.  Speculations on future opportunities to evolve Brayton powerplants aboard the space station  [NASA-TM-89863] p 121 N87-23674  ENNIX, KIMBERLY A.  Liquid propulsion technology for expendable and STS launch vehicle transfer stages	[NASA-TM-89295] p 79 N87-25836  EZAWA, NAOYA  Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547  FACIUS, R.  Radiation protection problems for the Space Station and approaches to their mitigation p 154 A87-49030  FAGET, MAXIME A.  The Industrial Space Facility p 167 A87-38579  FAGOT, CATHERINE Physiological requirements and pressure control of a spaceplane [SAE PAPER 860965] p 150 A87-38747  FANSON, J. L.  Positive position feedback control for large space structures [AIAA PAPER 87-0902] p 17 A87-33711  Structural control by the use of piezoelectric active members p 69 N87-24509  FANSON, JAMES Vibration suppression by stiffness control p 66 N87-22730  FANSON, JAMES L.  An experimental investigation of vibration suppression in large space structures using positive position feedback p 39 N87-28937  FARADAY, BRUCE J.  Testing of materials for solar power space applications p 159 N87-29989  FARRIA, JEFFERY T.  Analysis of on-orbit thermal characteristics of the 15-meter hoop/column antenna [NASA-TM-89137]  FARRANCE, MICHELLE A.

Development of experimental/analytical concepts for structural design verification [ESA-CR(P)-2340] p 36 N87-26075

Water recycling system using thermopervaporation nethod p 46 A87-32458

method

Dynamics during thrust maneuvers of flexible spinning satellites with axial and radial booms p 71 N87-25355

FELDMAN, L. A.	FORTEZZA, R.	FUKUDA, TOSHIO Flexibility control of torsional vibrations of a large solar
Effects on advanced materials: Results of the STS-8 EOIM (Effects of Oxygen Interaction with Materials)	Non-intrusive techniques for thermal measurements in microgravity fluid science experiments	array p 12 A87-32442
experiment	p 151 A87-39836	Vibration control for a linked system of flexible structures p 55 A87-32444
[AD-A182931] p 110 N87-29709	FORTINI, ANTHONY Mixing-induced ullage condensation and fluid	Control of flexible solar arrays with consideration of the
FENNELL, J.  Potential modulation on the SCATHA spacecraft	destratification	actuator dynamics of the reaction wheel
p 138 A87-34460	[AIAA PAPER 87-2018] p 92 A87-45357	p 55 A87-32448 Control of a flexible space manipulator
FENNELL, J. F. Potential modulations on SCATHA (Spacecraft Charging	FORTINI, ANTHONY F.	p 99 A87-32449
At High Altitude) spacecraft	Mixing-induced fluid destratification and ullage condensation p 95 N87-21149	Modeling and control of torsional vibrations in a flexible
[AD-A176815] p 140 N87-21024	FOSS, RICHARD A.	structure p 60 A87-50033
FEREBEE, MELVIN J., JR.	Thermal design of the ACCESS erectable space truss	FUKUNAGA, HISAO Taylored laminates with null or arbitrary coefficient of
Optimization of payload mass placement in a dual keel space station	p 42 A87-34469	thermal expansion p 107 A87-51794
[NASA-TM-89051] p 68 N87-23687	FOUDRIAT, EDWIN C.  Distributed computer taxonomy based on O/S	FULTON, ROBERT E.
FESMIRE, JAMES E.	structure p 116 N87-29127	A Lanczos eigenvalue method on a parallel computer [AIAA PAPER 87-0725] p 13 A87-33565
Quick-disconnect inflatable seal assembly [NASA-CASE-KSC-11368-1] p 102 N87-25583	FOUNDS, DAVID	Experiences with the Lanczos method on a parallel
[NASA-CASE-KSC-11368-1] p 102 N87-25583 FESTER, DALE A.	Joint Optics Structures Experiment (JOSE)	computer p 21 A87-41159
On-orbit fluid management p 132 A87-32543	p 34 N87-24497	FUNK, JOAN G.  Assessment of space environment induced
FETTERMAN, TIMOTHY L.	FOURNIER-SICRE, A. P.  A model for the estimation of the operations and	Assessment of space environment induced microdamage in toughened composite materials
Computational procedures for evaluating the sensitivity derivatives of vibration frequencies and Eigenmodes of	utilisation costs of an international space station	p 20 A87-38609
framed structures	p 168 A87-42267	FUNTOVA, I. I.
[NASA-CR-4099] p 40 N87-29899	FOURQUET, J. M.	Evaluation of physical work capacity of cosmonauts aboard Salyut-6 station p 157 N87-20735
FEURBACHER, B.  Scientific user requirements for microgravity research	On the possibility of a several-kilovolt differential charge in the day sector of a geosynchronous orbit	FURR, PAUL A.
(European aspects)	p 158 N87-26953	Physiological aspects of EVA
[AIAA PAPER 87-2195] p 153 A87-48581	FOWLER, B. L.	[SAE PAPER 860991] p 164 A87-38768
FICHTEL, CARL E.	Experimental characterization of deployable trusses and ioints p 33 N87-22749	FURUKAWA, MASAO  Development of fluid loop system for spacecraft
High energy gamma ray astronomy p 129 N87-24258	joints p 33 N87-22/49 <b>FOX, D. A.</b>	p 144 A87-32370
FIELDS, SUSAN T.	Power management equipment for space applications	FURUYA, HIROSHI
Design of a mixed fleet transportation system to low	[SAE PAPER 861621] p 74 A87-32578	Deployable surface truss concepts and two-dimensional adaptive structures p 144 A87-32341
Earth orbit. Volume 1: Executive summary. Volume 2: Near-term shuttle replacement. Volume 3: Heavy-lift cargo	FRANKLIN, S. BRUCE End-to-end communications for Space Station	adaptive structures privile section
vehicle. Volume 4: Advanced technology shuttle	p 85 A87-45522	G
replacement p 5 N87-29583	FREDERICKSON, A. R.	<b>G</b>
FINK, R. A.  Common drive unit p 104 N87-29869	Spacecraft dielectric material properties and spacecraft charging p 105 A87-33100	GAHN, RANDALL F.
Common drive unit p 104 N87-29869 FINLEY, J. A.	FREELAND, R. E.	Effect of component compression on the initial performance of an IPV nickel-hydrogen cell
Preliminary evaluation of a reaction control system for	Antenna Technology Shuttle Experiment (ATSE)	[NASA-TM-100102] p 79 N87-24838
the space station p 67 N87-22736	p 87 N87-24508	GAI, ELIEZER
FINZI, AMALIA ERCOLI  Active structural controllers emulating structural	FREEMAN, JANET E.  Design considerations for a one-kilometer antenna	On the performance analysis of a real-time distributed
elements by ICUs p 27 N87-20367	stick	computer system p 111 A87-31518 GALLOWAY, WILLIAM E.
Automatic docking maneuver and attitude control s	[AIAA PAPER 87-0871] p 15 A87-33635	Use of the Orbital Maneuvering Vehicle (OMV) for
ystem p 71 N87-25395 FISCHER, H.	FRIDMAN, A. M. Instability of an elastic filament in orbit around a	placement and retrieval of spacecraft and platforms
Report of the atmosphere panel p 161 N87-20633	gravitating center p 148 A87-32815	[AAS PAPER 86-041] p 133 A87-32743 GAMBERALE, R.
FISCHER, JAMES C.	Critical length for stable elongated orbiting structures	Data management system architecture options for space
Planning for future operational sensors and other	p 148 A87-32819	stations
priorities [NOAA-NESDIS-30] p 130 N87-25560	FRIEDMAN, ROBERT  Fire safety concerns in space operations	[SES/DNP/TR/002/85] p 115 N87-28585
FISHER, H. T.	[NASA-TM-89848] p 165 N87-20342	GANDIKOTA, KAPAL  An integrated analytic tool and knowledge-based system
On-orbit assembly and repair p 135 A87-40376	FRIMOUT, D.	approach to aerospace electric power system control
FISHER, ROBERT R.  Optimal shuttle altitude changes using tethers	Microgravity experiments onboard Eureca p 155 A87-53554	[SAE PAPER 861622] p 74 A87-32579
[AD-A179205] p 129 N87-22756	FUENTES, M.	GANSVIND, I. N. Gravity-gradient stabilization of the Salyut 6-Soyuz
FITZ-COY, N. G.	Service Manipulator Arm (SMA) for a Robotic Servicing	orbital complex p 147 A87-32801
Initial investigations into the damping characteristics of wire rope vibration isolators	Experiment (ROSE) [ESA-CR(P)-2347] p 103 N87-28260	GARAS, ANTHONY G.
[NASA-CR-180698] p 28 N87-20569	FUJII, HARUHISA	Star topology spacecraft data bus p 112 A87-37431
Space Station/Shuttle Orbiter dynamics during	Laboratory simulation of plasma interaction with high	GARBA, J.
docking p 65 N87-22708 FLAMENT, P.	voltage solar array p 145 A87-32388  FUJII, HIRONORI	Optimal placement of excitations and sensors for
Computer simulation of deployment	The mission function control for deployment and retrieval	verification of large dynamical systems [AIAA PAPER 87-0782] p 19 A87-33755
p 10 N87-29002	of subsatellite	GARBA, J. A.
FLANDERS, HOWARD A.	[AIAA PAPER 87-2326] p 126 A87-50447 FUJIMORI, HIROAKI	System identification for large space structure damage
Tethered satellite program control strategy [AAS PAPER 86-221] p 123 A87-38570	Development of carbon dioxide removal system -	assessment p 33 N87-22750
FLEETER, S.	Experimental study of solid amines p 145 A87-32456	GARBA, JOHN A.  On orbit damage assessment for large space
The effect of circumferential aerodynamic detuning on	FUJIMORI, YOSHINORI Structure and function of Deployable Truss Beam	structures
coupled bending-torsion unstalled supersonic flutter	(DTB) p 12 A87-32548	[AIAA PAPER 87-0870] p 15 A87-33634
[ASME PAPER 86-GT-100] p 166 A87-25396 FLEGER, STEPHEN A.	Evaluation testing of a mechanical actuator component	Verification of large beam-type space structures p 31 N87-22712
User interface design guidelines for expert	operating in a simulated space environment	GARCIA, KATHY D.
troubleshooting systems p 6 A87-33050	p 160 A87-32549 FUJITA, MASAHARU	Computer simulation of on-orbit manned maneuvering
FLORES, C.	Observation of precipitation from space by the weather	unit operations [SAE PAPER 861783] p 47 A87-32632
Advanced Solar GaAs Array (ASGA) experiment on EURECA: Flight objectives and instrument configuration	radar p 145 A87-32507	GARCIA, RAFAEL
p 83 N87-28985	FUJITA, T.  Nuclear reactor power for an electrically powered orbital	Results on reuse of reclaimed shower water
FLUGEL, CHARLES	transfer vehicle	[SAE PAPER 860983] p 50 A87-38762
Maintenance evaluation for space station liquid systems p 52 N87-21155	[AIAA PAPER 87-1102] p 76 A87-41145	GARLICK, GEORGE F. J.  Design study of large area 8 cm x 8 cm wrapthrough
systems p 52 N87-21155 FOGLEMAN, GORDON V.	FUJITA, TOSHIO  Nuclear reactor power for a space-based radar. SP-100	cells for space station p 80 N87-26424
Habitability issues for the Science Laboratory Module	project	GARMAN, JOHN R.
[SAE PAPER 860971] p 50 A87-38753	[NASA-TM-89295] p 79 N87-25838	The Space Station software support environment - Not
FONG, MICHAEL C.	FUJIWARA, TERUO	just what, but why [AIAA PAPER 87-2208] p 114 A87-48593
External contamination environment of Space Station Customer Servicing Facility	A consideration to vibration control for a large space	£
	structures p 54 A87-32441	GARN, P. A.
[AIAA PAPER 87-1623] p 52 A87-43122	FUJIWARA, Y.	An advanced technology space station for the year 2025,
[AIAA PAPER 87-1623] p 52 A87-43122  FONTANA, ANTHONY  Status of the Mast experiment p 30 N87-22703	• • • • • • • • • • • • • • • • • • • •	

GARNIER,	CH
Dvnam	ic n

modeling and optimal control design for large flexible space structures p 26 N87-20358 GARRISON, JAMES

Analysis of on-orbit thermal characteristics of the 15-meter hoop/column antenna

[NASA-TM-89137] p 45 N87-21021 GARRISON, P. W.

Advanced propulsion activities in the USA

p 90 A87-41575 GARVEY, J. M.

Space Station options for constructing advanced solar sails capable of multiple Mars missions

[AIAA PAPER 87-1902] p 91 A87-45287

GATEWOOD, G. D. Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222

p 122 A87-35222 GAVIT, SARAH A.

Orbital modifications using forced tether-length variations p 124 A87-40858 GAZENKO, O. G.

Space biology and medicine on the twenty-fifth anniversary of the first spaceflight of Yuriy Alekseyevich Gagarin

p 157 N87-20732 GEHLING, R. N.

Benefits of passive damping as applied to active control of large space structures p 63 N87-20371 GEHLING, RUSSELL N.

Low-authority control through passive damping [AAS PAPER 86-004] p 55 A87-32730

Space station integrated wall design and penetration

damage control. Task 3: Theoretical analysis of penetration

[NASA-CR-1791661 p 39 N87-28582

GENOVESE, J. E.

Thermal design of a large spacecraft propulsion svstem

[AIAA PAPER 87-1863] p 44 A87-45258

GERHOLD, CARL H. Active vibration control in microgravity environment

p 72 N87-26700

GERLACH, LOTHAR

Improved solar generator technology for the EURECA

low Earth orbit p 159 N87-28974 GIANNOVARIO, J. A.

Science Research Facilities - Versatility for Space

[SAE PAPER 860958] p 119 A87-38742

GIBBINS. M. N.

Space station integrated wall design and penetration damage control

[NASA-CR-179165] p 39 N87-28581

GIBSON, J. S.

Integrated control/structure design and robustness [SAE PAPER 861821] p 6 A87-32657 Adaptive identification of flexible structures by lattice

filters [AIAA PAPER 87-2458] p 24 A87-50504 GILBERT, DAVID W.

System level verification applying the Space Shuttle experience to the Space Station

[AAS PAPER 86-001] p 55 A87-32727

Attitude control of a spacecraft using an extended self-organizing fuzzy logic controller p 59 A87-41617 GILLAN, DOUGLAS J.

Space Station Food System

[SAE PAPER 860930] p 48 A87-38720

GINTY, C. A. Composite space antenna structures - Properties and environmental effects p 20 A87-38610 GIRARD, A.

Low frequency vibration testing on satellites

p 27 N87-20364

GIVENS, JOHN J. An astrometric facility for planetary detection on the Space Station pace Station p 127 A87-50750 An astrometric facility for planetary detection on the space station

[NASA-TM-89436] p 128 N87-20841

GLAESE, JOHN R.

Contact dynamics math model

[NASA-CR-179147] p 71 N87-25801 GLASER, H.

Development of experimental/analytical concepts for structural design verification

[ESA-CR(P)-2340] p 36 N87-26075 GLASER, R. J.

Validation of large space structures by ground tests D 11 A87-32336

Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical p 8 N87-20581

GLASS, B. J.

An Al-based model-adaptive approach to flexible structure control [AIAA PAPER 87-2457]

GLENN, DEAN

p 61 A87-50503

An electromechanical attenuator/actuator for Space Station docking p 138 N87-29878 GLUCK, R.

On a balanced passive damping and active vibration suppression of large space structures [AIAA PAPER 87-0901] p 19 A87-34701

GODFREY, ROBERT D. Feasibility study on 8PSK, QPSK, TFM, by using CLASS

for Space Station/TDRSS real measured channel p 113 A87-45485

GODWARD, J. L. Thermal design of a large spacecraft propulsion

[AIAA PAPER 87-1863] p 44 A87-45258 GOEL, P. S.

Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356 GOLDBERG, MICHAEL J.

Problems in merging Earth sensing satellite data sets INASA-TM-87820] p 129 N87-22457 GOLUB, MORTON A.

Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197

GONZALO, R. Service Manipulator Arm (SMA) for a Robotic Servicing

Experiment (ROSE) [ESA-CR(P)-2347] p 103 N87-28260 GOO. S. D.

Environmental avoidance concepts for steerable Space Station radiators [SAE PAPER 861831]

p 41 A87-32665 GOPALAN, A. U. Design and fabrication of Stretched Rohini Satellite-1

p 83 N87-29006 GOPIKANTH, M. L.

A Space Station utility - Static Feed Electrolyze [SAE PAPER 860920] p 47 A87-38712 GORDON, T.

Contamination assessment for OSSA space station IOC [NASA-CR-4091] p 53 N87-26086

GORIN, BARNEY F.

Refueling satellites in space - The OSCRS program [SAE PAPER 861797] p 88 A87-32645 Operation of the orbital spacecraft consumables resupply system (OSCRS) at the Space Station [AIAA PAPER 87-1768] p 135 A87-45192 GORKAVYI, N. N.

Critical length for stable elongated orbiting structures p 148 A87-32819

GORSKI, RAYMOND J.

National space transportation studies (SAE PAPER 861681) p 160 A87-32598 GOSSAIN, DEV

The Canadian Robotic System for the Space Station [AIAA PAPER 87-1677] p 100 A87-41153 p 100 A87-41153 GOULD, G. J.

On-orbit assembly and repair p 135 A87-40376 GRAETCH, JOSEPH E. Hydrogen/oxygen economy for the space station

p 98 N87-26130

GRAHAM, WILLIAM R.

Control operations in advanced aerospace systems p 54 A87-32117

Comparison of different attitude control schemes for

large communications satellites [AIAA PAPER 87-2391] p 61 A87-50475 GRANDHI, R. V.

Structural optimization with frequency constraints [AIAA PAPER 87-0787] p 13 A87-33588 Structural and control optimization of space structures [AIAA PAPER 87-0939] p 17 A87-33737

**GRANT, TERRY** Advanced local area network concepts

p 117 N87-29153 GRANTHAM, WALTER J.

Aeroassisted orbital maneuvering using Lyapunov optimal feedback control [AIAA PAPER 87-2464]

p 93 A87-50509 GRANTHAM, WILLIAM L. Controls-structures-electromagnetics interaction

program p 69 N87-24502 GRAY, ROBERT J.

Space suit reach and strength envelope considerations [SAE PAPER 860950] p 49 A87-38737

GRECHKO, G. M. Gravity-gradient stabilization of the Salyut 6-Soyuz p 147 A87-32801

GRECZYN. WARREN G.

A proposal for space tether damage indication, location, and evaluation - The Repair Monkey Module

p 125 A87-43354 GREELEY, S. W.

Reduced-order compensation - LQG reduction versus optimal projection [AIAA PAPER 87-2388]

p 61 A87-50472 GREELEY, SCOTT W.

Active damping control design for the COFS Mast Flight [AIAA PAPER 87-2321]

p 23 A87-50442 GREEN, B. D.

Chemical interactions in Low Earth Orbit (LEO) p 109 N87-26198

GREEN, JERRY Evaluation of the infrared test method for the Olympus thermal balance tests p 44 A87-46682

GREENBERG. JOEL S. Leadership in space transportation

p 170 A87-53989

GREENE, JOHN B., JR. Maintenance components for Space Station long life fluid systems [SAE PAPER 861005]

p 89 A87-38778 GREGORY, J. C. Interaction of hyperthermal atoms on surfaces in orbit:

The University of Alabama experiment

p 108 N87-26177 GRILIKHES, VLADIMIR ALEKSANDROVICH

Solar power satellites p 152 A87-44683 GRISHIN, SERGEI

Power plants in space p 155 A87-53560 GRONET, M. J.

Preliminary design, analysis, and costing of a dynamic scale model of the NASA space station [NASA-CR-4068]

p 36 N87-25606 GRONET, MARC J. COFS 3 multibody dynamics and control technology

p 69 N87-24506

GROSS, DAVID W.

Development of a standard connector for orbital replacement units for serviceable spacecraft p 40 N87-29864

GROSSI, MARIO D. Investigation of plasma contactors for use with orbiting

[NASA-CR-181422] p 131 N87-29591

GROSSMAN, M. Nuclear reactor power for an electrically powered orbital

transfer vehicle [AIAA PAPER 87-1102] p 76 A87-41145

GROSSMAN, MERLIN Nuclear reactor power for a space-based radar. SP-100

project [NASA-TM-89295] p 79 N87-25838 GROTE, M. G.

Enhanced evaporative surface for two-phase mounting

[SAE PAPER 860979] p 42 A87-38760 GRUBER, ROBERT P. Resistojet control and power for high frequency ac

buses [AIAA PAPER 87-0994] p 58 A87-41103 Resistojet control and power for high frequency ac

[NASA-TM-89860] p 63 N87-20477

GRUSZCZYNSKI, M. J. Design parameters and environmental considerations for a reusable aeroassisted orbital transfer vehicle [AIAA PAPER 87-1505] p 160 A87-43031

GUASTAFERRO, ANGELO Space Station - The next logical step

p 169 A87-47868 GUERIN, M.

Study of expert system applications to space projects NE-51-867] p 115 N87-26057 [NE-51-867] GUERRIERO, LUCIANO

Tethers in space; Proceedings of the International Conference, Arlington, VA, Sept. 17-19, 1986

p 123 A87-38567 **GUPTA, AMITAVA** 

Production of pulsed atomic oxygen beams via laser vaporization methods p 106 A87-38625 Degradation studies of SMRM teflon

p 106 A87-38641 O-atom degradation mechanisms of materials

p 141 N87-26178 Production of pulsed atomic oxygen beams via laser vaporization methods p 109 N87-26190 GUROVSKIY, N. N.

Space biology and medicine on the twenty-fifth anniversary of the first spaceflight of Yuriy Alekseyevich p 157 N87-20732

	Supercritical water oxidation - Concept analysis for	HARDY, A.
GUSTAFSON, ERIC	evolutionary Space Station application	Radiation environments and absorbed dose estimations
Space station active thermal control system modelling	[SAE PAPER 860993] p 51 A87-38770	on manned space missions p 139 A87-49026
GUSTAN FOITH	A simulation model for the analysis of Space Station	HARRIES, J. E.  Report of the atmosphere panel p 161 N87-20633
Science and payload options for animal and plant	gas-phase trace contaminants p 52 A87-53979	The post of the desired of the second of the
research accommodations aboard the early Space	HALLAUER, WILLIAM L., JR.	HARRIS, CINDY J.  Special considerations in outfitting a space station
Station	A comparison of active vibration control techniques -	module for scientific use
[SAE PAPER 860953] p 164 A87-38740	Output feedback vs optimal control [AIAA PAPER 87-0904] p 56 A87-33713	[SAE PAPER 860956] p 164 A87-38741
GUSTAN, EDITH A.  Plant and animal accommodation for Space Station	[AIAA PAPER 87-0904] p 56 A87-33713 An experimental study of transient waves in a plane	HARRIS, ELFRIEDA
Laboratory	grid structure	SOT: A rapid prototype using TAE windows
[SAE PAPER 860975] p 124 A87-38757	[AIAA PAPER 87-0943] p 18 A87-33741	p 114 N87-23161
CUVENNE T D	An analytical and experimental investigation of output	HARRIS, PHILIP R.
Proceedings of the Second International Symposium on	feedback vs. linear quadratic regulator	Innovations in space management - Macromanagement and the NASA heritage p 167 A87-34870
Spacecraft Flight Dynamics	[AIAA PAPER 87-2390] p 61 A87-50474	und the twice the
[204-81-200]	HALLINAN, G. J.	HARRISON, M. H.  Space Station - Opportunities for the life sciences
GWYNNE, PETER Space Station business p 169 A87-47726	Space station WP-04 power system. Volume 1:	p 122 A87-34871
CVIEDTHIAN A.A.	Executive summary [NASA-CR-179587-VOL-1] p 78 N87-23695	HART, SANDRA G.
Space biology and medicine on the twenty-fifth	Space station WP-04 power system. Volume 2: Study	Workshop on Workload and Training, and Examination
anniversary of the first spaceflight of Yuriy Alekseyevich	results	of their Interactions: Executive summary
Gagarin p 157 N87-20732	[NASA-CR-179587-VOL-2] p 79 N87-23696	[NASA-TM-89459] p 171 N87-25760
	HALPERN. BRET	HARTENSTEIN, R. Fiber ontic data systems p 117 N87-29152
H	Product energy distributions and energy partitioning in	
	O atom reactions on surfaces p 108 N87-26180	SS focused technology: Gateways and NOS's p 117 N87-29165
HAAG, THOMAS W.	HALSEMA, P. B.	HARTLEY, CRAIG S.
Preliminary performance characterizations of an engineering model multipropellant resistojet for space	Multiple beam phased array for Space Station Control	Use of heads-up displays, speech recognition, and
engineering model multipropellant resistojet toi space station application	Zone Communications p 85 A87-45519 HAM, FREDRIC M.	speech synthesis in controlling a remotely piloted space
TAIAA DADER 87-21201 D 93 A87-50197	Active damping control design for the COFS Mast Flight	vehicle p 99 A87-31493
Preliminary performance characterizations of an	System	Planning for unanticipated satellite servicing
engineering model multipropellant resistojet for space	[AIAA PAPER 87-2321] p 23 A87-50442	teleoperations p 118 A87-33048
station application	HAMAGUCHI, TATSUYA	HARTLEY, JAMES G.
[NASA-TM-100113] p 96 N87-23821	Solar concentrator system for experiments in the Space	Evaluation of Space Station thermal control
HABLANI, HARI B.  Modal analyses of dynamics of a deformable multibody	Station p 146 A67-32555 Structure and function of Deployable Truss Beam	techniques [SAE PAPER 860998] p 42 A87-38775
spacecraft - The Space Station: A continuum approach	(DTB) p 12 A87-32548	Development of an emulation-simulation thermal control
[AIAA PAPER 87-0925] p 17 A87-33727	HAMEL W.R.	model for space station application
HAETKA RAPHAFL T.	Application of a traction-drive 7-degrees-of-freedom	[NASA-CR-181009] p 45 N87-26072
Simultaneous structure/control optimization of large	telerobot to space manipulation	Development of an emulation-simulation thermal control
flexible spacecraft [AIAA PAPER 87-0823] p 14 A87-33610	[DE87-004616] p 101 N87-22231 Traction-drive telerobot for space manipulation	model for space station application
[AIAA PAPER 87-0823] p 14 A87-33610 A comparison of active vibration control techniques -	[DE87-005326] p 102 N87-22233	[NASA-CR-180312] p 45 N87-26936
Output feedback vs optimal control	Telerobotic technology for nuclear and space	Development of an emulation-simulation thermal control
[AIAA PAPER 87-0904] p 56 A87-33713	applications	model for space station application
Accuracy of derivatives of control performance using a	[NASA-CR-180923] p 102 N87-22242	(interest of the control of the cont
reduced structural model	HAMMOND, RONALD A.	HARTZELL, EARL J.  Workshop on Workload and Training, and Examination
[AIAA PAPER 87-0905] p 57 A87-33714	Space Station autonomy - What are the challenges? How can they be met? p 101 A87-53059	of their Interactions: Executive summary
An approach to structure/control simultaneous optimization for large flexible spacecraft	How can they be met? p 101 A87-53059 HANAGUD, S.	[NASA-TM-89459] p 171 N87-25760
p 22 A87-46793	Optimal vibration control by the use of piezoceramic	HARVEY, J. M.
An analytical and experimental investigation of output	sensors and actuators	GaAs concentrator solar arrays p 82 N87-28977
feedback vs. linear quadratic regulator	[AIAA PAPER 87-0959] p 18 A87-33751	HARVEY, M. S.
[AIAA PAPER 87-2390] p 61 A87-50474	An Al-based model-adaptive approach to flexible	A UK large diameter ion thruster for primary
HAGEDORN, P.  Active vibration damping of flexible structures using the	structure control [AIAA PAPER 87-2457] p 61 A87-50503	propulsion [AIAA PAPER 87-1031] p 89 A87-38015
traveling wave approach p 71 N87-25360	[70/04/70 20/00 20/00]	[AIAA PAPER 87-1031] p 89 A87-38015 HASEGAWA. T.
HAGILIND R. F.	HANKS, BRANTLEY R.  Future trends in spacecraft design and qualification	Space environmental effects on adhesives for the
The production of low-energy neutral oxygen beams by	p 2 N87-20356	Galileo spacecraft p 139 A87-38643
grazing-incidence neutralization p 131 N87-26191	Status of the Mast experiment p 30 N87-22703	HASHIMOTO, KAZUHIKO
HAGLUND, RICHARD F., JR.	HANSEN, IRVING G.	Communication missions for geostationary platforms
The role of electronic mechanisms in surface erosion and glow phenomena p 137 N87-26181	Space Station 20-kHz power management and distribution system p 75 A87-36913	p 84 A87-34797
and glow phenomena p 137 N87-26181	distribution system p 75 A67-36913 20 kHz Space Station power system	HASSELMAN, T. K.
Adaptive momentum management for the dual keel	p 76 A87-40378	MOVER II - A computer program for verifying reduced-order models of large dynamic systems
Space Station	EMC and power quality standards for 20-kHz power	[SAE PAPER 861790] p 5 A87-32639
[AIAA PAPER 87-2596] p 62 A87-50558	distribution	A computer program for model verification of dynamic
Adaptive momentum management for large space	[NASA-TM-89925] p 78 N87-22004	systems p 31 N87-22710
structures (NASA-CR-179085] p 67 N87-22758	HANSMAN, R. JOHN  The coupled dynamics of fluids and spacecraft in low	HASTINGS, DANIEL E.
HAHN H	gravity and low gravity fluid measurement	The radiation impedance of an electrodynamic tether
Multi-axis vibration tests on spacecraft using hydraulic	p 94 N87-21147	with end connectors p 125 A87-42585
exciters p 8 N87-20373	HANSON, JOHN M.	HATAYAMA, SHIGEKI
HAILE, W. B.	Combining space-based propulsive maneuvers and	Gas and water recycling system for IOC vivarium experiments p 46 A87-32457
Vibration isolation for line of sight performance	aerodynamic maneuvers to achieve optimal orbital	experiments p 46 A67-32457 HATFIELD, J. J.
improvement p 67 N67-22142 HAINES, RICHARD F.	transfer [AIAA PAPER 87-2567] p 93 A87-49617	Electronic control/display interface technology
Design and development of a Space Station proximity	HARADA, H.	p 88 N87-29161
operations research and development mockup	Development of the electrical power subsystem for the	HATHAWAY, ROY
[SAE PAPER 861785] p 133 A87-32634	electric propulsion experiment onboard the Space Flyer	Developing Space Station, II - Power, rendezvous,
HALE, ARTHUR L	Unit (SFU)	docking and remote sensing are important elements of
Large spacecraft pointing and shape control p 69 N87-24498	[AIAA PAPER 87-1040] p 76 A87-39628	the opace chance.
•	HARADA, MINORU  Japanese experiment module data management and	HATTIS, PHILIP D.  Shout a chit flight control design lessons - Direction for
HALL, J. B.  High capacity demonstration of honeycomb panel heat	communication system p 147 A87-32542	Shuttle orbit flight control design lessons - Direction for Space Station p 58 A87-37295
nines	HARADA, Y.	Space Station p 58 A87-37295 HAVILAND, J. K.
[SAE PAPER 861833] p 41 A87-32666	Space stable thermal control coatings	The control of linear dampers for large space
Evaluation of Space Station thermal control	[AD-A182796] p 110 N87-28584	structures
techniques	HARCROW, H. W.	[AIAA PAPER 87-2251] p 60 A87-50415
[SAE PAPER 860998] p 42 A87-38775	Benefits of passive damping as applied to active control of large space structures p 63 N87-20371	Digital control system for space structure dampers
HALL, JOHN B., JR.	HARDING, R. R.	[NASA-CR-181253] p 72 N87-27704
Effects of varying environmental parameters on trace contaminant concentrations in the NASA Space Station	The multi-disciplinary design study. A life cycle cost	HAWKES, THADDEUS A.
Reference Configuration	algorithm	An advanced geostationary communications platform p 125 A87-43165
[SAE PAPER 860916] p 47 A87-38708	[NASA-CR-178192] p 9 N87-21995	p 120 7101 40100

HELPPIE, MARTHA

HENDERSON, ERIC

[NASA-CR-180920]

Soviet space stations as analogs, second edition

An integrated analytic tool and knowledge-based system

approach to aerospace electric power system control [SAE PAPER 861622] p 74 A87-32579

p 157 N87-21996

HAY, STUART S. HENDRICKS, HERBERT D. HOFFBAUER, M. H. Preliminary performance characterizations of an Fiber optics wavelength division Mass spectrometers and atomic oxygen engineering model multipropellant resistojet for space multiplexing(components) p 117 N87-29151 p 141 N87-26176 station application Fiber optics common transceiver module HOFFMAN, DAVID J. [AIAA PAPER 87-2120] p 93 A87-50197 p 117 N87-29160 Effect of nozzle geometry on the resistojet exhaust Preliminary performance characterizations of an HENDRIX, S. P. engineering model multipropellant resistojet for space EDC development and testing for the Space Station [AIAA PAPER 87-2121] p 62 A87-52252 station application program Resistojet plume and induced environment analysis [NASA-TM-100113] [SAE PAPER 860918] n 96 N87-23821 p 118 A87-38710 [NASA-TM-88957] p 96 N87-24536 HAYASHI, SIGERU HENNIGES, BEN L HOFFMAN, R. W. Active damping control design for the COFS Mast Flight Gas and water recycling system for IOC vivarium Oxygen interaction with space-power materials p 46 A87-32457 experiments [NASA-CR-181396] p 132 N87-29633 [AIAA PAPER 87-2321] HAYASHI, TOMONAO p 23 A87-50442 HOFFMANN, HANS E. W. HEPPNER, DENNIS B. Thermal verification method for large sized spacecraft The industrial use of Spacelab p 168 A87-40286 Control/monitor instrumentation for environmental p 144 A87-32368 HOGGATT, J. T. control and life support systems aboard the Space HAYASHIGUCHI, SATOSHI International SAMPE Technical Conference, 18th, Station Thermal verification method for large sized spacecraft [SAE PAPER 861007] p 52 A87-38779 Seattle, WA, Oct. 7-9, 1986, Proceedings p 144 A87-32368 p 167 A87-38576 HÉRNDON, J. N. HAYWOOD, D. Traction-drive telerobot for space manipulation HOHLFELD, ROBERT GaAs concentrator solar arrays p 82 N87-28977 [DE87-005326] p 102 N87-22233 Investigation of plasma contactors for use with orbiting HEALEY MIKE Telerobotic technology for nuclear and space Mass storage systems for data transport in the early [NASA-CR-181422] applications p 131 N87-29591 space station era 1992-1998 NASA-CR-1809231 p 102 N87-22242 HOLCOMB, LEE [NASA-TM-87826] n 115 N87-27443 HERRING, MARK Overview of the NASA automation and robotics research HEATH, ELLEN F. Conceptual design of the High-Resolution Imaging rogram p 100 A87-33867 Development of a standard connector for orbital Spectrometer (HIRIS) for EOS p 126 A87-44185 replacement units for serviceable spacecraft HERSTROM, CATHERINE L. GPS applications to the Space Station p 40 N87-29864 Quasi-static shape adjustment of a 15 meter diameter p 136 A87-45525 HEBRARD, PAUL pace antenna HOLZACH, H. PEEK (Polyether ether ketone) with 30 percent of carbon [AIAA PAPER 87-0869] p 15 A87-33633 Study on investigation of the attitude control of large fibres for injection molding p 22 A87-44588 HIGUCHI, K. flexible spacecraft. Phase 2, volume 1: Executive Status of Japanese Experiment Module design HECKERT, B. J. A 25-LBF gaseous oxygen/gaseous hydrogen thruster [ESA-CR(P)-2361-VOL-1] Japanese Experiment Module (JEM) preliminary design n 73 N87-27707 for space station application p 98 N87-26132 HONVAULT, CLAUDE HECKS K p 151 A87-41570 ESA's future integrated space data system [AIAA PAPER 87-2190] p 153 Japanese customer needs for Space Station Mechanical design of the Eurostar platform p 153 A87-48578 [AIAA PAPER 87-2193] p 153 A87-48580 p 149 A87-34874 HOOVER, DANIEL J. HIGUCHI, KEN HEDGEPETH, JOHN M. Space Station based options New concepts of deployable truss units for large space for orbiter Structural concepts for large solar concentrators docking/berthing p 138 N87-29877 structures [NASA-CR-4075] p 65 N87-21994 HOPKINS, M. [AIAA PAPER 87-0868] p 14 A87-33632 HEESCHEN. G. HIGUCHI, KIYOSHI Adaptive momentum management for the dual keel Aerospatiale solar arrays, in orbit performance Development of carbon dioxide removal system -Space Station p 159 N87-28988 Experimental study of solid amines p 145 A87-32456 [AIAA PAPER 87-2596] p 62 A87-50558 HEFNER. L HILBRANDT, E. HOPKINS, MIRIAM Data management system architecture options for space Investigation for damping design and related nonlinear Space station momentum management vibrations of spacecraft structures p 64 N87-20668 [SES/DNP/TR/002/85] p 115 N87-28585 [FMSR-64/85] p 35 N87-24516 HOPMANN, HELMUT HEFNER, R. D. HILCHEY, JOHN D. Status and tendencies for low to medium thrust Robust controller design using frequency domain Science and payload options for animal and plant propulsion systems research accommodations aboard the early Space p 11 A87-32229 [IAF PAPER 86-162] p 90 A87-42680 HEGGEN, PHILIP M. Station HORIO. M. Design considerations for long-lived glass mirrors for [SAE PAPER 860953] p 164 A87-38740 Mission scheduling expert system and its space station p 123 A87-36531 HILL, DAVID G. C. applications Development status of a two-phase thermal [AIAA PAPER 87-2221] p 7 A87-48602 nanagement system for large spacecraft Control of an autonomous spacecraft rendezvous and HORN. F. L. docking maneuver by means of image processing [SAE PAPER 861828] p 41 A87-32662 Nuclear propulsion systems for orbit transfer based on [DGLR PAPER 86-122] D 101 A87-48156 HILL OLIVER the particle bed reactor HEIMBOLD, G. Aero-Assisted Orbital Transfer Vehicle (AOTV) [DE87-010060] Study on investigation of the attitude control of large p 99 N87-28405 p 3 N87-20682 HORNER, GARNETT C. flexible spacecraft. Phase 1, volume 1: Technical report Microprocessor controlled proof-mass actuator [ESA-CR(P)-2361-VOL-1] p 73 N87-27706 International SAMPE Technical Conference, 18th, Study on investigation of the attitude control of large exible spacecraft. Phase 2, volume 1: Executive Seattle, WA, Oct. 7-9, 1986, Proceedings p 167 A87-38576 p 65 N87-22706 HORNUNG, E. Recent developments and future trends in structural summary HINES, B. D. dynamic design verification and qualification of large [ESA-CR(P)-2361-VOL-1] p 73 N87-27707 Concepts for space maintenance of OTV engines Study on investigation of the attitude control of large flexible spacecraft, phase 3 flexible spacecraft p 156 N87-20357 p 135 A87-41161 Concepts for space maintenance of OTV engines Development of experimental/analytical concepts for ESA-CR(P)-2361-VOL-4] p 73 N87-27709 structural design verification p 136 A87-46000 [ESA-CR(P)-2340] HEIZER, B. L. Concepts for space maintenance of OTV engines p 36 N87-26075 Environmental avoidance concepts for steerable Space HORTA, LUCAS G. Station radiators HINRICHSEN, R. L. Effects of atmosphere on slewing control of a flexible [SAF PAPER 861831] p 41 A87-32665 The effects of structural perturbations on decoupled structure p 22 A87-47809 HEJTMANCIK, KELLY E. control HOSFORD, GREGORY S. Expansion of space station diagnostic capability to Hydrogen-oxygen thruster with no products of include serological identification of viral and bacterial Preliminary results of CHARGE-2 tethered payload combustion in exhaust plume p 53 N87-26703 experiment [AIAA PAPER 87-1775] p 91 A87-45196 HELD, DAN HOSOGAI, HIDEMI Frequency dispersion in the admittance of the polycrystalline Cu2S/CdS solar cell p 5 A87-29133 The Earth Observing System (EOS) synthetic aperture Flexibility control of torsional vibrations of a large solar radar (SAR) p 126 A87-44187 p 12 A87-32442 HELLER, JACK HOCHSTEIN, J. I. Control of flexible solar arrays with consideration of the Nuclear reactor power for a space-based radar, SP-100 Temperature fields due to jet induced mixing in a typical actuator dynamics of the reaction wheel project OTV tank p 55 A87-32448 [NASA-TM-89295] [AIAA PAPER 87-2017] p 79 N87-25838 p 93 A87-52247 Modeling and control of torsional vibrations in a flexible HELMREICH, ROBERT I HOCHSTEIN, JOHN I. p 60 A87-50033 The undersea habitat as a space station analog: Numerical modelling of cryogenic propellant behavior HOTES, DEBORAH Evaluation of research and training potential in low-G p 95 N87-21148 An evaluation of candidate oxidation resistant materials [NASA-CR-180342] p 53 N87-27405 HODGE, JOHN D.

The Space Station overview

Orbit (LEO) simulation facility

facility for material degradation studies

High intensity 5 eV CW laser sustained 0-atom exposure

High intensity 5 eV atomic oxygen source and Low Earth

HOFFBAUER, M. A.

p 168 A87-41571

p 105 A87-32060

p 141 N87-26186

p 107 N87-25480

oxidation resistant

p 110 N87-26203

p 135 A87-40376

p 82 N87-28977

for space applications in LEO

An evaluation of candidate

On-orbit assembly and repair

GaAs concentrator solar arrays

[NASA-TM-100122]

HOUSTON, S. J.

HOWARD J

p 160 A87-32598

HOWELL, DAVID	Maximum Entropy/Optimal Projection (MEOP) control	ISHIKAWA, TAKASHI
Data storage systems technology for the Space Station	design synthesis: Optimal quantification of the major design	Taylored laminates with null or arbitrary coefficient of thermal expansion p 107 A87-51794
era	tradeoffs p 9 N87-22741	thermal expansion p 107 A87-51/94 ISHLINSKII, A. IU.
[AIAA PAPER 87-2202] p 113 A87-48587	HYMAN, J.  Automatic charge control system for geosynchronous	The Gagarin scientific lectures in astronautics and
HOWLAND, T. P.  Complex system monitoring and fault diagnosis using	satellites p 87 N87-26960	aviation, 1985 p 152 A87-42923
communicating expert systems p 119 A87-40363		The Gagarin Scientific Lectures on Astronautics and Aviation 1986 p 169 A87-51869
HOYNIAK, D.	1	Aviation, 1986 p 169 A87-51869 ISOGAI, MASAHIRO
The effect of circumferential aerodynamic detuning on	ı	Vibration control for a linked system of flexible
coupled bending-torsion unstalled supersonic flutter [ASME PAPER 86-GT-100] p 166 A87-25396	IANSHIN, A. M.	structures p 55 A87-32444
HUANG, JEN-KUANG	Choice of the optimal angular position of a spacecraft	ITANAMI, TAKAO
Single-mode projection filters for identification and state	in the constant-solar-orientation flight segment	On-board K- and S-band multi-beam antennas p 86 A87-46281
estimation of flexible structures	p 148 A87-34207	ITO, TORU
[AIAA PAPER 87-2387] p 24 A87-50471	IATSYNIN, NIKOLAI ALEKSANDROVICH	Prediction of random vibrational responses of a large
Projection filters for modal parameter estimate for	Structure and design of spacecraft p 155 A87-51870	spacecraft in acoustic environment by BLPF method
flexible structures [NASA-CR-180303] p 38 N87-26583	IBRAHIM, A. M.	p 144 A87-32334
HUBBARD, JAMES E., JR.	Transient dynamics of orbiting flexible structural	IVEY, E. W.
Active vibration control of a simply supported beam using	members p 54 A87-32338	Space station structures and dynamics test program p 33 N87-22751
a spatially distributed actuator p 23 A87-50232	A formulation for studying dynamics of N connected flexible deployable members p 21 A87-41574	IVEY, EDWARD W.
HUENERS, E.	flexible deployable members p 21 A87-41574  A formulation for studying steady state/transient	Space station structures and dynamics test program
Development of experimental/analytical concepts for structural design verification	dynamics of a large class of spacecraft and its	[NASA-TP-2710] p 28 N87-20568
[ESA-CR(P)-2340] p 36 N87-26075	application p 35 N87-25357	IWASAKI, KAZUO
HUENERS, H.	IIDA, TAKASHI	Adaptive planar truss structures and their vibration characteristics
Modal-survey testing for system identification and	An enclosed hangar concept for large spacecraft	[AIAA PAPER 87-0743] p 148 A87-33667
dynamic qualification of spacecraft structures	servicing at Space Station p 146 A87-32534	IWATA, T.
p 27 N87-20365	Communication missions for geostationary platforms p 84 A87-34797	Study of actuator for large space manipulator arm
HUETER, UWE Evaluation of cryogenic system test options for the OTV	Japan's space development programs for	p 12 A87-32545
on-orbit propellant depot	communications - An overview p 152 A87-43156	A master-slave manipulator system for space use p 147 A87-32546
[AIAA PAPER 87-1498] p 90 A87-43027	IIZUKA, I.	IWATA, TAKANORI
HÜGHES, P. C.	Japanese customer needs for Space Station [AIAA PAPER 87-2193] p 153 A87-48580	System and operation analyses of OTV Network - A
Dynamics of gyroelastic spacecraft p 59 A87-47811	[AIAA PAPER 87-2193] p 153 A87-48580 HZUKA, ISAO	new space transportation concept p 145 A87-32475
HUGHES, PETER C.  Space structure vibration modes - How many exist?	Japanese experiment module data management and	IWATA, TOSHIAKI
Which ones are important? p 11 A87-32120	communication system p 147 A87-32542	Development of harmonic drive actuator for space manipulator p 149 A87-35076
HUGHES, ROBERT O.	IJICHI, K.	
Linear quadratic control system design for Space Station	Development of control and monitor subsystem for	Development of a small-sized space manipulator p 101 A87-51979
pointed payloads [AIAA PAPER 87-2530] p 161 A87-50533	electric propulsion experiment onboard Space Flyer Unit	•
[AIAA PAPER 87-2530] p 161 A87-50533 Impact of space station appendage vibrations on the	(SFU) [AIAA PAPER 87-1041] p 76 A87-39629	ī
pointing performance of gimballed payloads	IJICHI, KOICHI	J
p 32 N87-22733	Laboratory simulation of plasma interaction with high	
HUMPHRIES, W. R.	voltage solar array p 145 A87-32388	JABBARI, FARYAR  Adaptive identification of flexible structures by lattice
Status of the Space Station environmental control and	IKEGAMI, R.  Experimental characterization of deployable trusses and	filters
life support system design concept	joints p 33 N87-22749	[AIAA PAPER 87-2458] p 24 A87-50504
[SAE PAPER 860943] p 48 A87-38730	IKEGAMI, ROY	JACOT, A. D.
HUMPHRIES, WILLIAM R.  Space Station environmental control and life support	The design and analysis of passive damping for	High speed simulation of flexible multibody dynamics
system distribution and loop closure studies	aerospace systems	p 33 N87-22738
[SAE PAPER 860942] p 48 A87-38729	[AIAA PAPER 87-0891] p 58 A87-39644	JAFFE, L.
HUNT, DAVID L.	IKEUCHI, M.  Japanese data relay satellite system	Nuclear reactor power for an electrically powered orbita
A modern approach for modal testing using multiple input	[AIAA PAPER 87-2199] p 154 A87-48585	transfer vehicle [AIAA PAPER 87-1102] p 76 A87-41145
sine excitation	IMAI, RYOICHI	JAFFE, LEONARD
[AIAA PAPER 87-0964] p 19 A87-33754	Structural design and component tests of large	Nuclear reactor power for a space-based radar. SP-100
HUNT, J. J. Proceedings of the Second International Symposium on	geostationary satellite bus p 144 A87-32335	project
Spacecraft Flight Dynamics	IMAI, RYOUICHI Development of fluid loop system for spacecraft	[NASA-TM-89295] p 79 N87-25838
[ESA-SP-255] p 171 N87-25354	p 144 A87-32370	JAFFE, R. L.
HUNT, J. W.	INDERBITZEN, REBECCA S.	Potential surfaces for O atom-polymer reactions p 109 N87-2620
Configuration tradeoffs for the space infrared telescope	Energy expenditure during simulated EVA workloads	JAFFE, RICHARD L.
facility pointing control system p 121 A87-32236	[SAE PAPER 860921] p 163 A87-38713	Potential energy surfaces for atomic oxygen reactions
HUNTON, D. E.	INMAN, D. J.  Vibration suppression using a constrained rate-feedback	Formation of singlet and triplet biradicals as primar
Mass spectrometers and atomic oxygen p 141 N87-26176	Threshold control strategy	reaction products with unsaturated organic molecules
HURLEY, K.	[AIAA PAPER 87-0741] p 6 A87-33665	p 108 N87-2618
The Signe II gamma-ray burst experiment aboard the	Response bounds for linear underdamped systems	JAGOW, BRUCE
Prognoz 9 satellite p 150 A87-38443	[ASME PAPER 87-APM-34] p 59 A87-42505	Space Station EVA systems trade-off model [SAE PAPER 860990] p 134 A87-3876
HUSS, R. L.	INMAN, DANIEL J.  Square root state estimator for large space structures	JAIN. ANDREAS
Commercial US transfer vehicle overview	[AIAA PAPER 87-2389] p 24 A87-50473	Preliminary analysis of a prototype space solar power
[SAE PAPER 861764] p 1 A87-32625	INOUE, MASAO	system
HUTH, G.	Precise pointing control of flexible spacecraft	[ÍLR-MITT-168] p 79 N87-2453
GPS applications to the Space Station p 136 A87-45525	p 55 A87-32446	JAMAR, PAMELA
HUTTENBACH, ROBIN C.	Development of a small-sized space manipulator	Head-ported display analysis for Space Station
An evolutionary approach to the development of a	p 101 A87-51979	
CELSS based air revitalization system	Payload boomerang technology for space experiments	JANIK, DANIEL S.  Quality requirements for reclaimed/recycled water
[SAE PAPER 860968] p 49 A87-38750	at very low gravity level p 146 A87-32540	[NASA-TM-58279] p 53 N87-2739
HUYER, STEPHEN A.	IRBE, ROBERT	JANSSEN, D. R.
An equivalent continuum analysis procedure for Space	Results on reuse of reclaimed shower water	Summary of recent SAR instrument studies
Station lattice structures [AIAA PAPER 87-0724] p 13 A87-33564	[SAE PAPER 860983] p 50 A87-38762	p 159 N87-2786
HWANGBO, HAN	IRBY, THOMAS M.  National space transportation studies	JEANES, DENNIS P.
High thermal capacity evaporator and condensers for	[SAE PAPER 861681] p 160 A87-32598	A multiple attribute decision analysis of manned airloc
Space Station thermal control p 41 A87-32377	ISHIJIMA, SHINTARO	systems [AD-A179241] p 137 N87-2368
HYLAND, D. C.	The mission function control for deployment and retrieval	JEBENS, HAROLD J.
The Mast Flight System dynamic characteristics and	of subsatellite [AIAA PAPER 87-2326] p 126 A87-50447	Space colonization - T minus 20 (years) and holding
actuator/sensor selection and location [AAS PAPER 86-003] p 13 A87-32729	[AIAA PAPER 87-2326] p 126 A87-50447 ISHIKAWA, M. Y.	p 166 A87-3228
[AAS PAPER 86-003] p 13 A87-32/29 Reduced-order compensation - LQG reduction versus	Toward the year 2000: The near future of the American	JENKINS, JAMES C.
optimal projection	civilian and military space programs	National space transportation studies
[AIAA PAPER 87-2388] p 61 A87-50472	[DE87-006467] p 171 N87-22697	[SAE PAPER 861681] p 160 A87-3259

optimal projection [AIAA PAPER 87-2388]

Alternative power generation concepts for space

Design parameters and environmental considerations for a reusable aeroassisted orbital transfer vehicle

A microgravity isolation mount

p 27 N87-20366

p 81 N87-28961

p 161 N87-29861

p 160 A87-43031

stowed solar array JONES, BARBARA I.

[AIAA PAPER 87-1505]

JONES, D. I.

JONES, G. R.

PERSONAL AUTHOR INDEX		KEDROV, B. M.
JENKINS, LYLE M.	JONES, L.	K
System architecture for the telerobotic work system	Space station propulsion test bed: A complete system	K
[AAS PAPER 86-044] p 99 A87-32746 Telerobotic work system: Concept development and	p.98_N87-26131	KAASE, H.
evolution p 104 N87-29866		Absolute indoor calibration of large area solar cells
JENSEN, G. A.	satellites	p 159 N87-29015 KAJII. M.
Joint technology for graphite epoxy space structures	[AIAA PAPER 85-0387] p 7 A87-41611	Japanese data relay satellite system
p 20 A87-38600 JENSEN, J. KERMIT	JONES, OGDEN S.  Mixing-induced ullage condensation and fluid	[AIAA PAPER 87-2199] p 154 A87-48585
Mobile remote manipulator vehicle system	Mixing-induced ullage condensation and fluid destratification	KALYANASUNDARAM, S.
[NASA-CASE-LAR-13393-1] p 103 N87-29118	[AIAA PAPER 87-2018] p 92 A87-45357	Dynamic response of a viscoelastic Timoshenko beam [AIAA PAPER 87-0890] p 16 A87-33708
JENSEN, ROBERT L.  Space Station end effector strategy study	Mixing-induced fluid destratification and ullage condensation n 95 N87-21149	KAMENETSKAIA, E. P.
[NASA-TM-100488] p 103 N87-29593	JONES, P. ALAN	Legal problems concerning manned space flight
JETLEY, R. L.	Space Station alpha joint bearing p 83 N87-29882	p 151 A87-40339 KAMMER, DANIEL C.
Space station experiment definition: Long-term cryogenic fluid storage	JONES, R. E.	Comparison of the Craig-Bampton and residual flexibility
[NASA-CR-4072] p 97 N87-24641	High speed simulation of multi-flexible-body systems with large rotations	methods of substructure representation
JEWELL, R. E.	[AIAA PAPER 87-0930] p 57 A87-33730	p 19 A87-34510 KANDA, SHUJI
Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728	High speed simulation of flexible multibody dynamics	Preliminary experimental study on the oxygen separating
JHA, V. K.	p 33 N87-22738 JONES, ROBERT E.	and concentrating system for CELSS p 46 A87-32455
Optimization of aerospace structures subjected to	Space station propulsion system technology	Development of carbon dioxide removal system -
random vibration and fatigue constraints	[NASA-TM-100108] p 97 N87-25422	Experimental study of solid amines p 145 A87-32456 KANG, CHOONG S.
p 29 N87-20599 JI, HYUN-CHUL	Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135	Dynamic analysis of the flexible boom in the N-ROSS
Temperature fields due to jet induced mixing in a typical	[NASA-TM-100110] p 98 N87-26135 JONES. W. E.	satellite
OTV tank	Hubble Space Telescope satellite servicing	[AD-A181488] p 72 N87-26966 KARDOMATEAS, G. A.
[AIAA PAPER 87-2017] p 93 A87-52247  JOHANSSON, O.	[SAE PAPER 861796] p 133 A87-32644	Effect of transverse shearing forces on buckling and
Radiation heat transfer calculations for space	JORDAN, PAUL R. A cost effective 300 Mbps space-to-ground	postbuckling of delaminated composites under
structures [AIAA PAPER 87-1522] p 44 A87-44830	A cost effective 300 Mbps space-to-ground communications subsystem for the Space Station	compressive loads [AIAA PAPER 87-0877] p 105 A87-33639
JOHENNING, BERND	program p 113 A87-45521	KARNICK, DREW A.
Preliminary analysis of a prototype space solar power	JOSEPH, K. T.  A basis change strategy for the reduced gradient method	Moving-bank multiple model adaptive estimation applied
system [ILR-MITT-168] p 79 N87-24532	and the optimum design of large structures	to flexible spacestructure control [AD-A178870] p 68 N87-22761
JOHNSON, C. L.	p 23 A87-48341	KASAI, RITAROH
The Vanderbilt University neutral O-beam facility	JOSHI, S. M. Robust controller synthesis for a large flexible space	Laboratory simulation of plasma interaction with high
JOHNSON, CATHERINE C. p 105 A87-32059	antenna p 84 A87-32235	voltage solar array p 145 A87-32388  KASHIWASE, TOSHIO
Life Science Research Facility materials management	JUANG, JN.	Precise pointing control of flexible spacecraft
requirements and concepts [SAE PAPER 860974] p 124 A87-38756	Vibration suppression using a constrained rate-feedback Threshold control strategy	p 55 A87-32446
[SAE PAPEH 860974] p 124 A87-38756 JOHNSON, D. L.	[AIAA PAPER 87-0741] p 6 A87-33665	KATO, T.
Upper and Middle Atmospheric Density Modeling	JUANG, JER-NAN	Mission scheduling expert system and its space station applications
Requirements for Spacecraft Design and Operations [NASA-CP-2460] p 64 N87-20665	Effects of atmosphere on slewing control of a flexible structure	[AIAA PAPER 87-2221] p 7 A87-48602
JOHNSON, DERRICK W.	structure p 22 A87-47809 Robust eigensystem assignment for flexible structures	KATZ, I.  Theory of plasma contactors for electrodynamic tethered
The design and analysis of passive damping for aerospace systems	[AIAA PAPER 87-2252] p 23 A87-50416	satellite systems p 85 A87-41609
[AIAA PAPER 87-0891] p 58 A87-39644	Single-mode projection filters for identification and state	Ram ion scattering caused by Space Shuttle v x B
JOHNSON, E. H.	estimation of flexible structures [AIAA PAPER 87-2387] p 24 A87-50471	induced differential charging p 140 A87-51713
ASTROS - A multidisciplinary automated structural design tool	Slewing control experiment for a flexible panel	Documentation for the SHADO particle wake routine [AD-A181531] p 131 N87-26967
[AIAA PAPER 87-0713] p 6 A87-33557	p 78 N87-22740	KATZBERG, STEPHEN J.
JOHNSON, GARY	Research in slewing and tracking control	Space Station end effector strategy study [NASA-TM-100488] p 103 N87-29593
Habitation module for the Space Station [SAE PAPER 860928] p 163 A87-38718	p 70 N87-24512 JUDAY, RICHARD D.	KAUFFMAN, DAVID
JOHNSON, J. C.	Optical correlator use at Johnson Space Center	An analysis of bipropellant neutralization for spacecraft
International SAMPE Technical Conference, 18th, Seattle, WA, Oct. 7-9, 1986, Proceedings	p 59 A87-42655 JUDD, M. D.	refueling operations p 97 N87-25888 KAUFFMAN, R. R.
p 167 A87-38576	Materials for space applications p 106 A87-44741	The multi-disciplinary design study. A life cycle cost
JOHNSON, KEVIN D.	JUENGST, C. D.	algorithm [NASA-CR-178192] p.9 N87-21995
Design of a mixed fleet transportation system to low Earth orbit. Volume 1: Executive summary. Volume 2:	High speed simulation of flexible multibody dynamics	KAWADA, M.
Near-term shuttle replacement. Volume 3: Heavy-lift cargo	p 33 N87-22738 JUHASZ, ALBERT	Study of actuator for large space manipulator arm
vehicle. Volume 4: Advanced technology shuttle replacement n.5. NR7-29583	Selection of high temperature thermal energy storage	p 12 A87-32545 KAWAGUCHI, SHINTARO
JOHNSON, KURT P.	materials for advanced solar dynamic space power systems	A consideration to vibration control for a large space
Perspectives on materials processing in space [AAS PAPER 86-103] p.170 A87-53083	[NASA-TM-89886] p 78 N87-22174	structures p 54 A87-32441 KAWAKAMI, KUNIHIKO
JOHNSON, MARJORY J.	JUHASZ, ALBERT J.	Solar concentrator system for experiments in the Space
Proof that timing requirements of the FDDI token ring	Alternative power generation concepts for space p 81 N87-28961	Station p 146 A87-32535
protocol are satisfied p 112 A87-42821	JUILLET, J. J.	Structure and function of Deployable Truss Beam (DTB) p 12 A87-32548
JOHNSON, RICHARD D.	Aerospatiale solar arrays, in orbit performance	KAWASAKI, MASAHIRO
Space colonization - T minus 20 (years) and holding	p 159 N87-28988	Space Station program in a long-range space development scenario of Japan p 145 A87-32530
JOHNSON, TIMOTHY L.	JUNGE, M. A maintenance work station for Space Station	KAWASHIMA, N.
Flexible system model reduction and control system	[SAE PAPER 860933] p 167 A87-38723	Preliminary results of CHARGE-2 tethered payload
design based upon actuator and sensor influence	JUNKINS, J. L.	experiment p 121 A87-32521 KEAFER, LLOYD S.
JONES, A. S.	A quasi-analytical method for non-iterative computation of nonlinear controls p 66 N87-22731	Large space antennas: A systems analysis case
Modal testing of the Olympus development model	JUNKINS, JOHN L.	NISTORY
stowed solar array p 27 N87-20366	Debugge	[NASA-1M-89072] p 26 N87-20352

p 14 A87-33591

p 16 A87-33669

p 23 A87-50416

p 135 A87-40376

KEATES, T. F.

KECKLER, CLAUDE R.

Robustness optimization of structural and controller

An identification method for flexible structures

Robust eigensystem assignment for flexible structures [AIAA PAPER 87-2252] p 23 A87-50416

JUSTAFERRO, A.

parameters [AIAA PAPER 87-0791]

[AIAA PAPER 87-0745]

On-orbit assembly and repair

KEDROV, B. M.

K.E. Tsiolkovskii and problems in the development of science and technology p 151 A87-40342

Influence co-efficient testing as a substitute for modal

Control of flexible structures and the research

survey testing of large space structures

p 27 N87-20369

p 66 N87-22732

## **KEFAUVER, NEILL**

	KNOX, J.
KEFAUVER, NEILL Near-field testing of the 5-meter model of the tetrahedral	A method of variable spacing for controlled plant growth
truss antenna	systems in spaceflight and terrestrial agriculture
[NASA-CR-178147] p 30 N87-21987	applications [NASA-CR-177447] p 130 N87-25767
KEINHOLZ, D. A.  Experimental characterization of deployable trusses and	KOBAYASHI, TAKEHIKO
joints p 33 N87-22/49	Thermal deformation and electrical degradation of antenna reflector with truss backstructure
KELLY, BRIAN K.  A systems analysis of emergency escape and recovery	p 12 A87-32405
systems for the US space station	KOCH, JUERGEN W.
[AD-A179233] p.3 N87-23680	AMOC: An alternative module configuration for advanced solar arrays in low Earth orbits
KEMPSTER, LINDA  Mass storage systems for data transport in the early	p 159 N87-28968
space station era 1992-1998	KOELLE, D. E.
KENNEDY, JOHN J.	The single-stage reusable ballistic launcher concept for economic cargo transportation p 135 A87-41573
The preloadable vector sensitive latch for orbital	KOELLE, HEINZ-HERMANN
docking/berthing p 162 N87-29876	Preliminary analysis of a prototype space solar power
KERINNIS, OLAF Preliminary analysis of a prototype space solar power	system [ILR-MITT-168] p 79 N87-24532
system	KOLKAILAH, FAYSAL A.
KERSTEIN. L.	Gas tungsten arc welding in a microgravity environment:
The evolution of a serviceable EURECA	KOLSCH. I.
[MBB-UR-E-923/86] p 121 N87-26841	Investigation for damping design and related nonlinear
Orbital transfer vehicle concept definition and system	vibrations of spacecraft structures
analysis study. Volume 1A: Executive summary. Phase 2	[EMSB-64/85] p 35 N87-24516  KOMATSU, TAKAHIRO
[NASA-CR-179055] p 161 N87-21018	Development of fluid loop system for spacecraft
KHOT, N. S. Structural and control optimization of space structures	p 144 A87-32370
[AIAA PAPER 87-0939] p 17 A87-33737	KORI, MORIS  Product energy distributions and energy partitioning in
KHOURY, JIM M.	O atom reactions on surfaces p 108 N87-26180
Control/monitor instrumentation for environmental control and life support systems aboard the Space	KOSEKI, YASUO
Station	Water recycling system using thermopervaporation method p 46 A87-32458
[SAE PAPER 861007] p 52 A87-38779	method p 46 A67-32436  KOSMO, JOSEPH J.
KIA, T.  Nuclear reactor power for an electrically powered orbital	Space suit extravehicular hazards protection
transfer vehicle	development [NASA-TM-89355] p 53 N87-27407
[AIAA PAPER 87-1102] p 76 A87-41145	KOSMODEM'IANSKII, A. A.
KIBE, SEISHIRO Structure and function of Deployable Truss Beam	K.E. Tsiolkovskii and problems in the development of
(DTB) p 12 A87-32548	science and technology p 151 A87-40342
KIDA, TAKASHI	KOVACH, LICIA S.  Environmental Control Life Support for the Space
Local control for large space structures p 54 A87-32440	Station
A preliminary study on a linear inertial actuator for LSS	[SAE PAPER 860944] p 48 A87-38731
control p 55 A87-32447	KOWALEK, J.  A study of fluid transfer management in space
An enclosed hangar concept for large spacecraft	[FTMS-RPT-006] p 97 N87-26058
	KOZLOV, S. V.
Payload boomerang technology for space experiments at very low gravity level p 146 A87-32540	Determination of the natural frequencies of the longitudinal and torsional vibrations of truss structures with
KIDGER, NEVILLE	attached rigid bodies p 152 A87-46121
Mir in action p 150 A87-37971	KRAIMAN, HOWARD
KILLEBREW, TIMOTHY D.  Military man in space: A history of Air Force efforts to	Communication and Data Management Systems for an
find a manned space mission	orbiting platform p 112 A87-40359  KRALL. A. M.
[AD-A179873] p 171 N87-25815	Modeling, stabilization and control of serially connected
KIM, IN-KUN Modeling of fluid transfer in orbit	beams p 21 A87-41052
[AIAA PAPER 87-1763] p 90 A87-45190	KRECH, ROBERT H.  A high flux pulsed source of energetic atomic oxygen
KIM. ZEEN C.	p 139 A87-38623
Interdisciplinary analysis procedures in the modeling and	Pulsed source of energetic atomic oxygen
control of large space-based structures p 22 A87-42678	p 108 N87-26189
KIM, ZEEN CHUL	KROLICZEK, E. J.  Design of an advanced two-phase capillary cold plate
An investigation of methodology for the control and	[SAE PAPER 861829] p 41 A87-32663
failure identification of flexible structures p 38 N87-26921	KRUEGER, MICHAEL
KING, C. B.	Preliminary analysis of a prototype space solar power
An advanced technology space station for the year 2025,	system [ILR-MITT-168] p 79 N87-24532
study and concepts [NASA-CR-178208] p 120 N87-20340	KRUMWEIDE, GARY C.
KIRKHART. J. L.	Measuring thermal expansion in large composite structures p 20 A87-38612
Evaluation of carbon-carbon for space engine nozzle	structures p 20 A67-36612  KU, J.
p 98 N87-26116	Design of an advanced two-phase capillary cold plate
KIRKPATRICK, MARC E.  Spacecraft environment interaction investigation	[SAE PAPER 861829] p 41 A87-32663
[AD-A179183] p 140 N87-23678	KUBAN, D. P.  Application of a traction-drive 7-degrees-of-freedom
KISSEL, GLEN J.	telerobot to space manipulation
Localization in disordered periodic structures [AIAA PAPER 87-0819] p 19 A87-33757	[DE87-004616] p 101 N87-22231
KITAMURA, KATSUHIDE	Traction-drive telerobot for space manipulation [DE87-005326] p 102 N87-22233
Development of graphite epoxy space structure	Traction-drive, seven-degree-of-freedom telerobot arm:
p 105 A87-32342	A concept for manipulaton in space p 104 N87-29867
KITTEL, PETER Transferring superfluid helium in space	KUBOTA, YUJI Prediction of random vibrational responses of a large
p 88 A87-34712	spacecraft in acoustic environment by BLPF method
Helium technology issues p 94 N87-21145	p 144 A87-32334
KLEINAU, W.	KUCZERA, H.  Micrometeorite exposure of solar arrays
The single-stage reusable ballistic launcher concept for	MICROTTELECTRE EXPOSURE OF SOLET BITTELES

p 135 A87-41573

KUMAR, K. KUNII. Y. KÙO, C. P.

KUHL, R.

Contribution of the German Democratic Republic (East Germany) to the 'Intercosmos' program of study of materials in space aboard the orbiting station Salyut 6 p 147 A87-32814

KULCHYSKI, R. B.

Use of a video-photogrammetry system for the measurement of the dynamic response of the shuttle p 101 N87-20370 remote manipulator arm

KUMAGIRI, YASUO

Evaluation testing of a mechanical actuator component operating in a simulated space environment

Analytical solutions for static elastic deformations of wire ropes [AIAA PAPER 87-0720] p 6 A87-33561 Initial investigations into the damping characteristics of

wire rope vibration isolators [NASA-CR-180698] p 28 N87-20569 A new approach for vibration control in large space p 33 N87-22743

KUMINECZ, J.

Review of Low Earth Orbital (LEO) flight experiments p 131 N87-26174

Development of the electrical power subsystem for the electric propulsion experiment onboard the Space Flyer Unit (SFU) [AIAA PAPER 87-1040] p 76 A87-39628

Development of control and monitor subsystem for electric propulsion experiment onboard Space Flyer Unit (SEU) p 76 A87-39629 [AIAA PAPER 87-1041]

Validation of large space structures by ground tests

p 11 A87-32336 System identification of a truss type space structure using the multiple boundary condition test (MBCT) method

[AIAA PAPER 87-0746] p 16 A87-33670 Verification of flexible structures by ground test p 31 N87-22713

KUO, C-P.

Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical p 8 N87-20581 models

KUO, SHAU-HERN

Optimal nodal transfer and aeroassisted transfer by p 138 N87-28577 aerocruise

KURACHI, S.

Two-time-scale design of robust controllers for large p 12 A87-32443 structure systems KURIKI, KYOICHI

Advanced technology experiment onboard space p 122 A87-32536 platform KURITA, Y.

Study of actuator for large space manipulator arm p 12 A87-32545 KURITZ, STEVEN P.

Application of physical parameter identification to p 34 N87-24505 finite-element models KUROKAWA, HARUHISA

A study on singularity of single gimbal CMG systems p 149 A87-35077

KUROKAWA, HIDEAKI

Water recycling system using thermopervaporation p 46 A87-32458 method

KUSSMAUL, MICHAEL

An evaluation of candidate oxidation resistant p 110 N87-26203 materials

KUTYNA, FRANK

Space motion sickness status report p 163 A87-38714

[SAE PAPER 860923]

KUWAO, FUMIHIRO

Adaptive planar truss structures and their vibration characteristics

[AIAA PAPER 87-0743] p 148 A87-33667 The design and development of a two-dimensional p 40 N87-29860 adaptive truss structure

KUZNETSOV, A.

The Signe II gamma-ray burst experiment aboard the Prognoz 9 satellite p 150 A87-38443 p 150 A87-38443

p 82 N87-28982

KWATNY, H. G. Practical issues in computation of optimal, distributed

control of flexible structures p 25 A87-50507 [AIAA PAPER 87-2461]

Modeling and control of flexible structures p 29 N87-21388 [AD-A177106]

Spectral factorization and homogenization methods for modeling and control of flexible structures p 35 N87-24517 (AD-A1797261

economic cargo transportation

LARED	RICHARD

An evaluation of candidate oxidation resistant materials p 110 N87-26203

### LABUS, THOMAS L.

Space station electrical power system [NASA-TM-100140] p

p 80 N87-26144 LACOMBE, J. L.

Service Manipulator Arm (SMA) for a Robotic Servicing Experiment (ROSE) [ESA-CR(P)-2347] p 103 N87-28260

LACOVARA, ROBERT C.

p 37 N87-26085

Integration of communications and tracking data processing simulation for space station p 115 N87-25890

LACY, DOVIE E.

Selection of high temperature thermal energy storage materials for advanced solar dynamic space power systems

[NASA-TM-89886]

p 78 N87-22174 LAFRAMBOISE, J. G.

Spacecraft charging in the auroral plasma: Progress toward understanding the physical effects involved p 142 N87-26949

LAKE, MARK S.

Experimental evaluation of small-scale erectable truss hardware

[NASA-TM-89068] LALIBERTE, D.

SAGA: A project to automate the management of

software production systems FNASA-CR-1802761 p 10 N87-27412

LALLMAN, FREDERICK J.

Dual keel space station control/structures interaction study p 67 N87-22737

LAMB, J. PARKER

U.S. National Congress of Applied Mechanics, 10th, University of Texas, Austin, June 16-20, 1986,

[AD-A1819621

p 1 A87-40051 LANE, BARTON G. A preliminary study of extended magnetic field structures in the ionosphere

[NASA-CR-181004] p 140 N87-23066

LANG, JEFFREY H.

Flexible system model reduction and control system design based upon actuator and sensor influence p 59 A87-46301 functions

### LANGE, TH.

Study on investigation of the attitude control of large flexible spacecraft. Phase 1, volume 1: Technical report [ESA-CR(P)-2361-VOL-1] p 73 N87-27706 Study on investigation of the attitude control of large flexible spacecraft. Phase 2, volume 1: Executive

summary [ESA-CR(P)-2361-VOL-1] p 73 N87-27707 Study on investigation of the attitude control of large

flexible spacecraft, phase 3 [ESA-CR(P)-2361-VOL-4] p 73 N87-27709

LANGEMANN, M.

An advanced wind scatterometer for the Columbus Polar Platform payload

p 155 A87-53117 LANGER W. D Groundbased studies of spacecraft glow and erosion

caused by impact of oxygen and nitrogen beams p 109 N87-26200

## LANGTON, CHARAN J.

End-to-end communications for Space Station

p 85 A87-45522 LANTRIP, DAVID B.

ISOKIN - A quantitative model of the kinesthetic aspects of spatial habitability p 162 A87-33002

LANZ. MASSIMILIANO Active structural controllers emulating structural lements by ICUs p 27 N87-20367

elements by ICUs LANZEROTTI, LOUIS, J. A crisis in the NASA space and earth sciences

programme p 112 A87-37968 LANZL, F.

Land panel report p 128 N87-20634 LARKINS, J. T.

A Space Station utility - Static Feed Electrolyzer [SAE PAPER 860920] p 47 A87-38712

LARSEN, RON Overview of the NASA automation and robotics research p 100 A87-33867

LARSEN, RONALD L.

Proceedings: Computer Science and Data Systems Technical Symposium, volume 1

[NASA-TM-89285] p 116 N87-29124 Proceedings: Computer Science and Data Systems

Technical Symposium, volume 2 [NASA-TM-89286] p 116 N87-29144 LARSON, C. R.

Structural/control interaction (payload pointing and p 9 N87-22721

LASKIN, ROBERT A.

The Softmounted Inertially Reacting Pointing System [AAS PAPER 86-007] p 56 A87-32732 On the inadequacies of current multi-flexible body

simulation codes [AIAA PAPER 87-2248]

p 7 A87-50412

p 42 A87-38734

Potential surfaces for O atom-polymer reactions p 109 N87-26201

LATHAM, P. M.

LASKOWSKI, B. C.

A UK large diameter ion thruster for primary propulsion [AIAA PAPER 87-1031] p 89 A87-38015

LAUBER, R. J.

Automated software production
[AIAA PAPER 87-2219]

p 2 A87-48601 LAUFENBERG, ROBERT S.

Computer simulation of a rotational single-element

flexible spacecraft boom AD-A181798] p 103 N87-26968 LAUX. U.

System aspects of Columbus thermal control [SAE PAPER 860938] p 150 A87-38727

LAVENDER, K. E.

A UK large diameter ion thruster for primary propulsion

[AIAA PAPER 87-1031] p 89 A87-38015 LÀVIGNA, THOMAS A.

Servicing of user payload equipment in the Space Station pressurized environment

[SAE PAPER 860973] p 134 A87-38755

LAWSON, B. MIKE

Regenerable non-venting thermal control subsystem for extravehicular activity

[SAE PAPER 860947]

LÀWSON, R. System aspects of Columbus thermal control p 150 A87-38727

[SAE PAPER 860938] LAWTON, TONY

The Soviet space shuttle programme

p 153 A87-47302

LAZARETH, O.

Nuclear propulsion systems for orbit transfer based on the particle bed reactor [DE87-010060] p 99 N87-28405

LEBEAU ANDRE

The astronaut and the robot - Short- and long-term scenarios for space technology p 101 A87-53991 LEBEDEV, M. A.

Expected size of a crater resulting from the impact of micrometeorite p 119 A87-41870 LECHTE, H.

MARECS and ECS anomalies: Attempt at insulation defect production in Kapton p 82 N87-28980 LECHTE H G

Stopping differential charging of solar arrays p 83 N87-28984

LECHTE, HORST G.

Electrostatic immunity of geostationary satellites p 143 N87-26957

LEE, ALECK L.

External contamination environment of Space Station Customer Servicing Facility

[AIAA PAPER 87-1623] p 52 A87-43122

Aeroassisted orbital maneuvering using Lyapunov optimal feedback control AIAA PAPER 87-2464] p 93 A87-50509

LEE, C. Y. Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger

[AIAA PAPER 87-1540] p 44 A87-44843 LEE, S. W.

Dynamic finite element modeling of flexible structures AD-A1771681 p 30 N87-22252 LEE, W. Y.

Optimal trajectories for aeroassisted, coplanar orbital p 54 A87-31681

Selected materials issues associated with Space Station p 105 A87-32061 Review of Low Earth Orbital (LEO) flight experiments p 131 N87-26174

### LEGER, LUBERT

High intensity 5 eV atomic oxygen source and Low Earth Orbit (LEO) simulation facility p 141 N87-26186 LEGER, LUBERT J.

Material interactions with the Low Earth Orbital (LEO) environment: Accurate reaction rate measurements p 108 N87-26175

Space Station lubrication considerations

p 104 N87-29879

LEGOSTAEV, V. P.

Gravity-gradient stabilization of the Salyut 6-Soyuz orbital complex p 147 A87-32801

LEINWEBER, DAVID

Expert systems in space p 111 A87-32075

LEISEIFER. H. P.

Columbus Life Support System and its technology development [SAE PAPER 860966]

LEKAN, JACK

An advanced geostationary communications platform p 125 A87-43165

LEMAIGNEN, LOUIS

Physiological requirements and pressure control of a spaceplane

LEMKE, DIETRICH

[SAE PAPER 860965] p 150 A87-38747

The Space Station - Uses and users

p 151 A87-40513

p 4 N87-28583

p 148 A87-34345

p 140 N87-21991

p 69 N87-24506

p 150 A87-38748

LEMPRIERE, B. M.

Space station integrated wall design and penetration damage control. Task 4: Impact detection/location system

[NASA-CR-179167] LENOROVITZ, JEFFREY M.

Advances by the Soviet Union in space cooperation and

commercial marketing made 1986 a landmark year p 149 A87-34595

LERNER, ERIC J.

Robots on the Space Station p 100 A87-40844 LERNER, NARCINDA R.

Reactions of atomic oxygen (O(P-3)) with polybutadienes and related polymers p 109 N87-26197 LESOMA, S. K.

The synthesis of the power transmission channel for a satellite solar power station p 75 A87-35799 LESOTA, S. K.

Shape control of the directional pattern in a microwave-beam power transmission channel

LESTER, M.

The use of Pi2 pulsations as indicators of substorm effects at geostationary orbit LETAW, JOHN R. p 142 N87-26942

Radiation shielding requirements on long-duration space missions

(AD-A177512)

LETCHWORTH, ROBERT COFS 3 multibody dynamics and control technology

LEVADOU, FRANÇOIS

Enhancement of solar absorptance degradation due to contamination of solar radiator panels in geosynchronous - Correlation of flight data and laboratory measurements p 144 A87-32346

LEVITAN, LEE Head-ported display analysis for Space Station

applications p 111 A87-31463 LEVY. D. R. Mass property estimation for control of asymmetrical

satellites p 63 A87-52968 LEVY, E. H.

Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222

Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755

On the possibility of a several-kilovolt differential charge

in the day sector of a geosynchronous orbit p 158 N87-26953 MARECS and ECS anomalies: Attempt at insulation defect production in Kapton

p 82 N87-28980 LI, DECHANG Dynamics of a multibody system with relative translation on curved, flexible tracks

p 58 A87-40867 LI. FEIYUE Minimum time attitude slewing maneuvers of a rigid

spacecraft [NASA-CR-181130] p 72 N87-26038 The dynamics and control of large flexible space structures X, part 1

[NASA-CR-181287] p 73 N87-27712

LIANDRIS, MARIA Thermal test results of the two-phase thermal bus

technology demonstration loop

[AIAA PAPER 87-1627] p 44 A87-43125 LIANG, RANTY H.

Production of pulsed atomic oxygen beams via laser vaporization methods p 106 A87-38625 Degradation studies of SMRM teflon

p 106 A87-38641 O-atom degradation mechanisms of materials

p 141 N87-26178

Production of pulsed atomic oxygen beams via laser	LOUVIERE, ALLEN J.	MANNING, R. A.
vaporization methods p 109 N87-26190	Water-propellant resistojets for man-tended platforms	Control augmented structural synthesis with transient response constraints
LICHTENBERG, BYRON K.	[NASA-TM-100110] p 98 N87-26135	[AIAA PAPER 87-0749] p 56 A87-33573
Human capabilities in space [AAS PAPER 86-114] p 165 A87-53089	Lovelace, U. M.  Large space antennas: A systems analysis case	MANOS, D. M.
[AAS PAPER 86-114] p 165 A87-53089 LIENING, FREDERICK A.	history	Groundbased studies of spacecraft glow and erosion
CELSS waste management systems evaluation	[NASA-TM-89072] p 26 N87-20352	caused by impact of oxygen and nitrogen beams
[SAE PAPER 860997] p 51 A87-38774	LOVELL, ROBERT R.	p 109 N87-26200 MANTEGAZZA, PAOLO
LIKINS, PETER W.	The evolution of the geostationary platform concept	Active structural controllers emulating structural
Dynamics of a multibody system with relative translation on curved flexible tracks p 58 A87-40867	p 125 A87-43154	elements by ICUs p 27 N87-20367
on curved, flexible tracks p 58 A87-40867  LILES, PAUL D.	LOW, D. I. R. The Canadian space program p 143 A87-32281	MAO, C.
On board Data Management p 112 A87-40381	the canada space Frederick	Organic Rankine cycle power conversion systems for
LILLINGTON, DAVID R.	LUCAS, J. C. One Controller at a Time (1-CAT): A mimo design	space applications p 159 N87-28989
Design study of large area 8 cm x 8 cm wrapthrough	methodology p 65 N87-22715	MARCHETTI, M.  Evaluation of the built-in stresses and residual distortions
cells for space station p 80 N87-26424	LUDEWIG, H.	on cured composites for space antenna reflectors
LIM, KYONG B.  Robustness optimization of structural and controller	Nuclear propulsion systems for orbit transfer based on	applications p 22 A87-47327
parameters	the particle bed reactor	MARCUS, BETH A.
[AIAA PAPER 87-0791] p 14 A87-33591	[DE87-010060] p 99 N87-28405	Space Station Food System [SAF PAPER 860930] p 48 A87-38720
Robust eigensystem assignment for flexible structures	LUDLOW, GERRY	[SAE PAPER 860930] p 48 A87-38720 MARELLI, L.
[AIAA PAPER 87-2252] p 23 A87-50416	Space station power semiconductor package [NASA-CR-180829] p 81 N87-28825	Payload data management scheme planned for Earth
LIM, T. W.	LUEST, R.	observation sensors to be flown on the polar platforms
The control of linear dampers for large space structures	Cooperation between Europe and the United States in	in the framework of the space station/Columbus
[AIAA PAPER 87-2251] p 60 A87-50415	space (The Fulbright 40th Anniversary Lecture)	program p 114 N87-20630
LIN. C.	p 170 A87-53924	Data management panel report p 114 N87-20639
Environmental control and life support technologies for	LUEST, REIMAR	MARK, HANS MICHAEL The Space Station: A personal journey
advanced manned space missions	The European space programme p 150 A87-37962	p 169 A87-46975
[SAE PAPER 860994] p 51 A87-38771	LUKICH, M. S.	MARKER, W.
LIN, CAI Substructure analysis using NICE/SPAR and	On a balanced passive damping and active vibration	Space Station Information System integrated
Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures	suppression of large space structures [AIAA PAPER 87-0901] p 19 A87-34701	communications concept
[NASA-CR-180317] p 38 N87-27260	LUKICH, MICHAEL S.	[AIAA PAPER 87-2228] p 114 A87-48606
LINDLEY, THOMAS L.	Application of physical parameter identification to	Space Station Information System requirements for
On-board communications, including EVA	finite-element models p 34 N87-24505	integrated communications [AIAA PAPER 87-2229] p 114 A87-48607
p 85 A87-40380	LYNN, DAVID	MARKS. G.
LINDSAY, K. L.	Space Station opportunity for UK in earth sensing	Modal testing of the Olympus development model
Proposed CMG momentum management scheme for space station	p 152 A87-41678	stowed solar array p 27 N87-20366
[AIAA PAPER 87-2528] p 62 A87-50531	LYON, JOHN	MARTIN, A. R.
LIU, FRANK C.	Data capture and processing [AIAA PAPER 87-2203] p 113 A87-48588	The use of electric propulsion on low earth orbit spacecraft
Analytical determination of space station response to	LYRINTZIS, C. S.	[AIAA PAPER 87-0989] p 88 A87-38003
crew motion and design of suspension system for microgravity experiments p 67 N87-22752	Vibrations and structureborne noise in space station	A UK large diameter ion thruster for primary
	[NASA-CR-181381] p 39 N87-29590	propulsion
LLEWELLYN, E. J.  Spacecraft ram glow and surface temperature		[AIAA PAPER 87-1031] p 89 A87-38015
Spacecraft ram glow and surface temperature p 10 N87-26205	M	MARTIN, JOHN
Spacecraft ram glow and surface temperature p 10 N87-26205 LODGE, D. W. S.	M	MARTIN, JOHN  Mass storage systems for data transport in the early
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S. British activities in space p 143 A87-32280		MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280  Design of a polar platform with an earth observation	MA, PAUL T.	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280  Design of a polar platform with an earth observation payload p 122 A87-32538		MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280  Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H.	MA, PAUL T.  External contamination environment of Space Station	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443 MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280  Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H.  Life support subsystem concepts for botanical experiments of long duration	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility [AIAA PAPER 87-1623] p 52 A87-43122 MAAG, CARL R.	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  MARTINEZ-SANCHEZ, MANUEL
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280  Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H.  Life support subsystem experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S. British activities in space p 143 A87-32280 Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H. Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R.	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  MARTINEZ-SANCHEZ, MANUEL
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S. British activities in space p 143 A87-32280 Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H. Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R. Botanical payloads for platforms and space stations	MA, PAUL T. External contamination environment of Space Station Customer Servicing Facility [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R. Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858  MARTINEZ, A.  Concepts for space maintenance of OTV engines
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280  Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H.  Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R.  Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443 MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787 MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858 MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S. British activities in space Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H. Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] DESER, HELMUT R. Botanical payloads for platforms [MBB-UR-E-921/86] DFLAND, WILLIAM W., JR.	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858  MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161  Concepts for space maintenance of OTV engines
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280  Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H.  Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R.  Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340  LOFLAND, WILLIAM W., JR.  An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use p 147 A87-32546	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858  MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161  Concepts for space maintenance of OTV engines p 136 A87-46000
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280  Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H.  Life support subsystem concepts for botanical experiments of long duration [MBB-URE-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R.  Botanical payloads for platforms and space stations [MBB-URE-921/86] p 158 N87-25340  LOFLAND, WILLIAM W., JR.  An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784  LOFTUS, JOSEPH P.	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use p 147 A87-32546  MACHIDA, KAZUO	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443 MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787 MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858 MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161  Concepts for space maintenance of OTV engines p 136 A87-46000  Concepts for space maintenance of OTV engines
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S. British activities in space p 143 A87-32280 Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H. Life support subsystem concepts for botanical experiments of long duration [MBB-URE-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R. Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340  LOFLAND, WILLIAM W., JR. An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784  LOFTUS, JOSEPH P. Man's role in space exploration and exploitation	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use p 147 A87-32546  MACHIDA, KAZUO  Development of harmonic drive actuator for space	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858  MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161  Concepts for space maintenance of OTV engines p 136 A87-46000  Concepts for space maintenance of OTV engines p 137 N87-26097
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space period payload p 122 A87-32280  LOESER, H.  Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R.  Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340  LOFLAND, WILLIAM W., JR.  An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784  LOFTUS, JOSEPH P.  Man's role in space exploration and exploitation p 169 A87-46332	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use p 147 A87-32546  MACHIDA, KAZUO  Development of harmonic drive actuator for space manipulator p 149 A87-35076	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858  MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161  Concepts for space maintenance of OTV engines p 136 A87-46000  Concepts for space maintenance of OTV engines p 136 A87-46000  Service Manipulator Arm (SMA) for a Robotic Servicing Experiment (ROSE)
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S. British activities in space p 143 A87-32280 Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H. Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R. Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340  LOFLAND, WILLIAM W., JR. An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784  LOFTUS, JOSEPH P. Man's role in space exploration and exploitation p 169 A87-46332  LOGSDON, JOHN M.	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use p 147 A87-32546  MACHIDA, KAZUO  Development of harmonic drive actuator for space	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443 MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787 MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858 MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161 Concepts for space maintenance of OTV engines p 136 A87-46000 Concepts for space maintenance of OTV engines p 137 N87-26097 Service Manipulator Arm (SMA) for a Robotic Servicing Experiment (ROSE) [ESA-CR(P)-2347] p 103 N87-28260
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space period payload p 122 A87-32280  LOESER, H.  Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R.  Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340  LOFLAND, WILLIAM W., JR.  An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784  LOFTUS, JOSEPH P.  Man's role in space exploration and exploitation p 169 A87-46332	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use p 147 A87-32546  MACHIDA, KAZUO  Development of harmonic drive actuator for space manipulator p 149 A87-35076  Development of a small-sized space manipulator p 101 A87-51979  MACKIW, G. E.	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline p 75 A87-33787  MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858  MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161  Concepts for space maintenance of OTV engines p 136 A87-46000  Concepts for space maintenance of OTV engines p 137 N87-26097  Service Manipulator Arm (SMA) for a Robotic Servicing Experiment (ROSE) [ESA-CR(P)-2347] p 103 N87-28260
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280 Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H.  Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R.  Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340  LOFLAND, WILLIAM W., JR.  An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784  LOFTUS, JOSEPH P.  Man's role in space exploration and exploitation p 169 A87-46332  LOGSDON, JOHN M.  Reconstituting the US space programme p 168 A87-41218  Priorities and policy analysis - A response to Alex	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use p 147 A87-32546  MACHIDA, KAZUO  Development of harmonic drive actuator for space manipulator p 149 A87-35076  Development of a small-sized space manipulator p 101 A87-51979  MACKIW, G. E.  Multiple Access Ku-band communications subsystem for	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858  MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161  Concepts for space maintenance of OTV engines p 136 A87-46000  Concepts for space maintenance of OTV engines p 137 N87-26097  Service Manipulator Arm (SMA) for a Robotic Servicing Experiment (ROSE) [ESA-CR(P)-2347] p 103 N87-28260  MARTINEZ, PEDRO A.  Space station data management system - A common
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280  Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H.  Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R.  Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340  LOFLAND, WILLIAM W., JR.  An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784  LOFTUS, JOSEPH P.  Man's role in space exploration and exploitation p 169 A67-46332  LOGSDON, JOHN M.  Reconstituting the US space programme p 168 A67-41218	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use p 147 A87-32546  MACHIDA, KAZUO  Development of harmonic drive actuator for space manipulator p 149 A87-35076  Development of a small-sized space manipulator p 101 A87-51979  MACKIW, G. E.  Multiple Access Ku-band communications subsystem for the Space Station p 84 A87-31462	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline post forced tether-length variations using forced tether-length variations post forced tether-length post forced t
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280  Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H.  Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R.  Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340  LOFLAND, WILLIAM W., JR.  An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784  LOFTUS, JOSEPH P.  Man's role in space exploration and exploitation p 169 A87-46332  LOGSDON, JOHN M.  Reconstituting the US space programme p 168 A87-41218  Priorities and policy analysis - A response to Alex Roland p 168 A87-41222  LOH, Y. C.	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use p 147 A87-32546  MACHIDA, KAZUO  Development of harmonic drive actuator for space manipulator p 149 A87-35076  Development of a small-sized space manipulator p 101 A87-51979  MACKIW, G. E.  Multiple Access Ku-band communications subsystem for the Space Station p 84 A87-31462  MACKOWSKI, MAURA J.	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858  MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161  Concepts for space maintenance of OTV engines p 136 A87-46000  Concepts for space maintenance of OTV engines p 136 A87-46000  Concepts for space maintenance of OTV engines p 137 N87-26097  Service Manipulator Arm (SMA) for a Robotic Servicing Experiment (ROSE)  [ESA-CR(P)-2347] p 103 N87-28260  MARTINEZ, PEDRO A.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280  Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H.  Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R.  Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340  LOFLAND, WILLIAM W., JR.  An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784  LOFTUS, JOSEPH P.  Man's role in space exploration and exploitation p 169 A67-46332  LOGSDON, JOHN M.  Reconstituting the US space programme p 168 A67-41218  Priorities and policy analysis - A response to Alex Roland p 168 A87-41222  LOH, Y. C.  Antenna systems and RF coverage for the Space	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility  [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use p 147 A87-32546  MACHIDA, KAZUO  Development of harmonic drive actuator for space manipulator p 149 A87-35076  Development of a small-sized space manipulator p 101 A87-51979  MACKIW, G. E.  Multiple Access Ku-band communications subsystem for the Space Station p 84 A87-31462  MACKOWSKI, MAURA J.  Safety on the Space Station p 162 A87-35599	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858  MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161  Concepts for space maintenance of OTV engines p 136 A87-46000  Concepts for space maintenance of OTV engines p 137 N87-26097  Service Manipulator Arm (SMA) for a Robotic Servicing Experiment (ROSE)  [ESA-CR(P)-2347] p 103 N87-28260  MARTINEZ, PEDRO A.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  MARTINOVIC, ZORAN N.  A comparison of active vibration control techniques
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280  Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H.  Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R.  Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340  LOFLAND, WILLIAM W., JR.  An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784  LOFTUS, JOSEPH P.  Man's role in space exploration and exploitation p 169 A87-46332  LOGSDON, JOHN M.  Reconstituting the US space programme p 168 A87-41218  Priorities and policy analysis - A response to Alex Roland p 168 A87-41222  LOH, Y. C.  Antenna systems and RF coverage for the Space Station p 2 A87-45523	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use p 147 A87-32546  MACHIDA, KAZUO  Development of harmonic drive actuator for space manipulator p 149 A87-35076  Development of a small-sized space manipulator p 101 A87-51979  MACKIW, G. E.  Multiple Access Ku-band communications subsystem for the Space Station p 84 A87-31462  MACKOWSKI, MAURA J.  Safety on the Space Station p 162 A87-35599  MAEKAWA, SHOJI	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline p 75 A87-33787  MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858  MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161  Concepts for space maintenance of OTV engines p 136 A87-46000  Concepts for space maintenance of OTV engines p 137 N87-26097  Service Manipulator Arm (SMA) for a Robotic Servicing Experiment (ROSE)  [ESA-CR(P)-2347] p 103 N87-28260  MARTINEZ, PEDRO A.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  MARTINOVIC, ZORAN N.  A comparison of active vibration control techniques - Output feedback vs optimal control
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280  Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H.  Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R.  Botanical payloads for platforms and space stations [MBB-UR-E-921/96] p 158 N87-25340  LOFLAND, WILLIAM W., JR.  An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784  LOFTUS, JOSEPH P.  Man's role in space exploration and exploitation p 169 A87-46332  LOGSDON, JOHN M.  Reconstituting the US space programme p 168 A87-41218  Priorities and policy analysis - A response to Alex Roland p 168 A87-41222  LOH, Y. C.  Antenna systems and RF coverage for the Space Station p 2 A87-45523  LONGHURST, F.	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility  [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use p 147 A87-32546  MACHIDA, KAZUO  Development of harmonic drive actuator for space manipulator p 149 A87-35076  Development of a small-sized space manipulator p 101 A87-51979  MACKIW, G. E.  Multiple Access Ku-band communications subsystem for the Space Station p 84 A87-31462  MACKOWSKI, MAURA J.  Safety on the Space Station p 162 A87-35599  MAEKAWA, SHOJI  Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858  MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161  Concepts for space maintenance of OTV engines p 136 A87-46000  Concepts for space maintenance of OTV engines p 137 N87-26097  Service Manipulator Arm (SMA) for a Robotic Servicing Experiment (ROSE) [ESA-CR(P)-2347] p 103 N87-28260  MARTINEZ, PEDRO A.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  MARTINOVIC, ZORAN N.  A comparison of active vibration control techniques - Output feedback vs optimal control [AIAA PAPER 87-0904] p 56 A87-33713
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280  Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H.  Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R.  Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340  LOFLAND, WILLIAM W., JR.  An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784  LOFTUS, JOSEPH P.  Man's role in space exploration and exploitation p 169 A87-46332  LOGSDON, JOHN M.  Reconstituting the US space programme p 168 A87-41218  Priorities and policy analysis - A response to Alex Roland p 168 A87-41222  LOH, Y. C.  Antenna systems and RF coverage for the Space Station p 2 A87-45523	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use p 147 A87-32546  MACHIDA, KAZUO  Development of harmonic drive actuator for space manipulator p 149 A87-35076  Development of a small-sized space manipulator  P 101 A87-51979  MACKIW, G. E.  Multiple Access Ku-band communications subsystem for the Space Station p 84 A87-31462  MACKOWSKI, MAURA J.  Safety on the Space Station p 162 A87-35599  MAEKAWA, SHOJI  Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443 MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787 MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858 MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161  Concepts for space maintenance of OTV engines p 136 A87-46000  Concepts for space maintenance of OTV engines p 137 N87-26097  Service Manipulator Arm (SMA) for a Robotic Servicing Experiment (ROSE)  [ESA-CR(P)-2347] p 103 N87-28260  MARTINEZ, PEDRO A.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  MARTINOVIC, ZORAN N.  A comparison of active vibration control techniques - Output feedback vs optimal control [AIAA PAPER 87-0904] p 56 A87-33713 An analytical and experimental investigation of output
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280  Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H.  Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R.  Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340  LOFLAND, WILLIAM W., JR.  An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784  LOFTUS, JOSEPH P.  Man's role in space exploration and exploitation p 169 A87-46332  LOGSDON, JOHN M.  Reconstituting the US space programme p 168 A87-41218  Priorities and policy analysis - A response to Alex Roland p 169 A87-4523  LOH, Y. C.  Antenna systems and RF coverage for the Space Station p 2 A87-45523  LONGHURST, F.  The Columbus system baseline and interfaces p 156 A87-53923	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use p 147 A87-32546  MACHIDA, KAZUO  Development of harmonic drive actuator for space manipulator p 149 A87-35076  Development of a small-sized space manipulator p 101 A87-51979  MACKIW, G. E.  Multiple Access Ku-band communications subsystem for the Space Station p 84 A87-31462  MACKOWSKI, MAURA J.  Safety on the Space Station p 162 A87-35599  MAEKAWA, SHOJI  Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334  MALLA, RAMESH-BABU	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858  MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161  Concepts for space maintenance of OTV engines p 136 A87-46000  Concepts for space maintenance of OTV engines p 137 N87-26097  Service Manipulator Arm (SMA) for a Robotic Servicing Experiment (ROSE) [ESA-CR(P)-2347] p 103 N87-28260  MARTINEZ, PEDRO A.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  MARTINOVIC, ZORAN N.  A comparison of active vibration control techniques Output feedback vs. linear quadratic regulator
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280  Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H.  Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R.  Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340  LOFLAND, WILLIAM W., JR.  An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784  LOFTUS, JOSEPH P.  Man's role in space exploration and exploitation p 169 A87-46332  LOGSDON, JOHN M.  Reconstituting the US space programme p 168 A87-41218  Priorities and policy analysis - A response to Alex Roland p 168 A87-41222  LOH, Y. C.  Antenna systems and RF coverage for the Space Station p 2 A87-45523  LONGHURST, F.  The Columbus system baseline and interfaces p 156 A87-53923  LONGMAN, R. W.  Dynamics during thrust maneuvers of flexible spinning	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility  [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CAR R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use p 147 A87-32546  MACHIDA, KAZUO  Development of harmonic drive actuator for space manipulator p 149 A87-35766  Development of a small-sized space manipulator p 101 A87-51979  MACKIW, G. E.  Multiple Access Ku-band communications subsystem for the Space Station p 84 A87-31462  MACKOWSKI, MAURA J.  Safety on the Space Station p 162 A87-35599  MACKAWA, SHOJI  Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334  MALLA, RAMESH-BABU  Dynamic and thermal effects in very large space	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858  MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161  Concepts for space maintenance of OTV engines p 136 A87-46000  Concepts for space maintenance of OTV engines p 137 N87-26097  Service Manipulator Arm (SMA) for a Robotic Servicing Experiment (ROSE)  [ESA-CR(P)-2347] p 103 N87-28260  MARTINEZ, PEDRO A.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  MARTINOVIC, ZORAN N.  A comparison of active vibration control techniques - Output feedback vs optimal control [AIAA PAPER 87-0904] p 56 A87-33713  An analytical and experimental investigation of output feedback vs. linear quadratic regulator [AIAA PAPER 87-2390] p 61 A87-50474  MARUIZUMI, HARUKI
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280  Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H.  Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R.  Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340  LOFLAND, WILLIAM W., JR.  An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784  LOFTUS, JOSEPH P.  Man's role in space exploration and exploitation p 169 A87-46332  LOGSDON, JOHN M.  Reconstituting the US space programme p 168 A87-41218  Priorities and policy analysis - A response to Alex Roland p 169 A87-4523  LOH, Y. C.  Antenna systems and RF coverage for the Space Station p 2 A87-45523  LONGHURST, F.  The Columbus system baseline and interfaces p 156 A87-53923	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility  [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use p 147 A87-32546  MACHIDA, KAZUO  Development of harmonic drive actuator for space manipulator p 149 A87-35076  Development of a small-sized space manipulator p 101 A87-51979  MACKIW, G. E.  Multiple Access Ku-band communications subsystem for the Space Station p 84 A87-31462  MACKOWSKI, MAURA J.  Safety on the Space Station p 162 A87-35599  MAEKAWA, SHOJI  Prediction of random vibrational responses of a large spaceraft in acoustic environment by BLPF method p 144 A87-32334  MALLA, RAMESH-BABU  Dynamic and thermal effects in very large space structures p 25 N87-20347	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443 MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787 MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858 MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161 Concepts for space maintenance of OTV engines p 136 A87-46000 Concepts for space maintenance of OTV engines p 137 N87-26097 Service Manipulator Arm (SMA) for a Robotic Servicing Experiment (ROSE) [ESA-CR(P)-2347] p 103 N87-28260 MARTINEZ, PEDRO A.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294 MARTINOVIC, ZORAN N.  A comparison of active vibration control techniques Output feedback vs optimal control [AIAA PAPER 87-0904] p 56 A87-33713 An analytical and experimental investigation of output feedback vs. linear quadratic regulator (AIAA PAPER 87-2390) p 61 A87-50474 MARUIZUMI, HARUKI Evaluation testing of a mechanical actuator component
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S. British activities in space p 143 A87-32280 Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H. Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R. Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340  LOFLAND, WILLIAM W., JR. An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784  LOFTUS, JOSEPH P. Man's role in space exploration and exploitation p 169 A87-46332  LOGSDON, JOHN M. Reconstituting the US space programme p 168 A87-41218 Priorities and policy analysis - A response to Alex Roland p 168 A87-41222  LOH, Y. C. Antenna systems and RF coverage for the Space Station p 2 A87-45533  LONGHURST, F. The Columbus system baseline and interfaces p 156 A87-53923  LONGMAN, R. W. Dynamics during thrust maneuvers of flexible spinning satellites with axial and radial booms p 71 N87-25355  LORENZINI, ENRICO C.	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility  [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use p 147 A87-32546  MACHIDA, KAZUO  Development of harmonic drive actuator for space manipulator p 149 A87-35076  Development of a small-sized space manipulator p 101 A87-51979  MACKIW, G. E.  Multiple Access Ku-band communications subsystem for the Space Station p 84 A87-31462  MACKOWSKI, MAURA J. Safety on the Space Station p 162 A87-35599  MAEKAWA, SHOJI  Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334  MALLA, RAMESH-BABU  Dynamic and thermal effects in very large space structures p 25 N87-20347  MALLARY, WILLIAM E.  Space Station data management system architecture	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858  MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161  Concepts for space maintenance of OTV engines p 136 A87-46000  Concepts for space maintenance of OTV engines p 137 N87-26097  Service Manipulator Arm (SMA) for a Robotic Servicing Experiment (ROSE) [ESA-CR(P)-2347] p 103 N87-28260  MARTINEZ, PEDRO A.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  MARTINOVIC, ZORAN N.  A comparison of active vibration control techniques - Output feedback vs optimal control [AIAA PAPER 87-0904] p 56 A87-33713  An analytical and experimental investigation of output feedback vs. linear quadratic regulator (AIAA PAPER 87-2390)  MARUIZUMI, HARUKI  Evaluation testing of a mechanical actuator component operating in a simulated space environment
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280 Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H.  Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R.  Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340  LOFLAND, WILLIAM W., JR.  An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784  LOFTUS, JOSEPH P.  Man's role in space exploration and exploitation p 169 A87-46332  LOGSDON, JOHN M.  Reconstituting the US space programme p 168 A87-41218  Priorities and policy analysis - A response to Alex Roland p 168 A87-41222  LOH, Y. C.  Antenna systems and RF coverage for the Space Station p 2 A87-45523  LONGMURST, F.  The Columbus system baseline and interfaces p 156 A87-53923  LONGMAN, R. W.  Dynamics during thrust maneuvers of flexible spinning satellites with axial and radial booms p 71 N87-25355  LORENZINI, ENRICO C.  A three-mass tethered system for micro-g/variable-g	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility  [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use p 147 A87-32546  MACHIDA, KAZUO  Development of harmonic drive actuator for space manipulator p 149 A87-35076  Development of a small-sized space manipulator p 101 A87-51979  MACKIW, G. E.  Multiple Access Ku-band communications subsystem for the Space Station p 84 A87-31462  MACKOWSKI, MAURA J.  Safety on the Space Station p 162 A87-35599  MAEKAWA, SHOJI  Prediction of random vibrational responses of a large spaceraft in acoustic environment by BLPF method p 144 A87-32334  MALLA, RAMESH-BABU  Dynamic and thermal effects in very large space structures p 25 N87-20347  MALLARY, WILLIAM E.  Space Station data management system architecture p 111 A87-37293	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858  MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161  Concepts for space maintenance of OTV engines p 136 A87-46000  Concepts for space maintenance of OTV engines p 137 N87-26097  Service Manipulator Arm (SMA) for a Robotic Servicing Experiment (ROSE) [ESA-CR(P)-2347] p 103 N87-28260  MARTINEZ, PEDRO A.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  MARTINOVIC, ZORAN N.  A comparison of active vibration control techniques - Output feedback vs optimal control [AIAA PAPER 87-0904] p 56 A87-33713  An analytical and experimental investigation of output feedback vs. linear quadratic regulator (AIAA PAPER 87-2390) p 61 A87-50474  MARUIZUMI, HARUKI  Evaluation testing of a mechanical actuator component operating in a simulated space environment p 160 A87-32549
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280 Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H.  Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R.  Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340  LOFLAND, WILLIAM W., JR.  An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784  LOFTUS, JOSEPH P.  Man's role in space exploration and exploitation p 169 A67-46332  LOGSDON, JOHN M.  Reconstituting the US space programme p 168 A87-41218  Priorities and policy analysis - A response to Alex Roland p 168 A87-41222  LOH, Y. C.  Antenna systems and RF coverage for the Space Station p 2 A87-45523  LONGHURST, F.  The Columbus system baseline and interfaces p 156 A87-53923  LONGMAN, R. W.  Dynamics during thrust maneuvers of flexible spinning satellites with axial and radial booms p 71 N87-25355  LORENZINI, ENRICO C.  A three-mass tethered system for micro-g/variable-g applications	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use p 147 A87-32546  MACHIDA, KAZUO  Development of harmonic drive actuator for space manipulator p 149 A87-35076  Development of a small-sized space manipulator p 101 A87-51979  MACKIW, G. E.  Multiple Access Ku-band communications subsystem for the Space Station p 84 A87-31462  MACKOWSKI, MAURA J.  Safety on the Space Station p 162 A87-35599  MACKAWA, SHOJI  Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334  MALLA, RAMESH-BABU  Dynamic and thermal effects in very large space structures p 25 N87-20347  MALLARY, WILLIAM E.  Space Station data management system architecture p 111 A87-37293	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858  MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161  Concepts for space maintenance of OTV engines p 136 A87-46000  Concepts for space maintenance of OTV engines p 137 N87-26097  Service Manipulator Arm (SMA) for a Robotic Servicing Experiment (ROSE) [ESA-CR(P)-2347] p 103 N87-28260  MARTINEZ, PEDRO A.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  MARTINOVIC, ZORAN N.  A comparison of active vibration control techniques - Output feedback vs optimal control [AIAA PAPER 87-0904] p 56 A87-33713  An analytical and experimental investigation of output feedback vs. linear quadratic regulator [AIAA PAPER 87-2390] p 61 A87-50474  MARUIZUMI, HARUKI  Evaluation testing of a mechanical actuator component operating in a simulated space environment
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280 Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H.  Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R.  Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340  LOFLAND, WILLIAM W., JR.  An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784  LOFTUS, JOSEPH P.  Man's role in space exploration and exploitation p 169 A87-46332  LOGSDON, JOHN M.  Reconstituting the US space programme p 168 A87-41218  Priorities and policy analysis - A response to Alex Roland p 168 A87-41222  LOH, Y. C.  Antenna systems and RF coverage for the Space Station p 2 A87-45523  LONGHURST, F.  The Columbus system baseline and interfaces p 156 A87-53923  LONGMAN, R. W.  Dynamics during thrust maneuvers of flexible spinning satellites with axial and radial booms p 71 N87-25355  LORENZINI, ENRICO C.  A three-mass tethered system for micro-g/variable-g applications p 125 A87-40859  Analytical investigation of the dynamics of tethered	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility  [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CAR R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use p 147 A87-32546  MACHIDA, KAZUO  Development of harmonic drive actuator for space manipulator p 149 A87-35076  Development of a small-sized space manipulator p 101 A87-51979  MACKIW, G. E.  Multiple Access Ku-band communications subsystem for the Space Station p 84 A87-31462  MACKOWSKI, MAURA J.  Safety on the Space Station p 162 A87-35599  MAEKAWA, SHOJI  Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334  MALLA, RAMESH-BABU  Dynamic and thermal effects in very large space structures p 25 N87-20347  MALLARY, WILLIAM E.  Space Station data management system architecture p 111 A87-37293  MALLETTE, MICHAEL FREDERICK  Theory and application of linear servo dampers for large	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858  MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161  Concepts for space maintenance of OTV engines p 136 A87-46000  Concepts for space maintenance of OTV engines p 137 N87-26097  Service Manipulator Arm (SMA) for a Robotic Servicing Experiment (ROSE) [ESA-CR(P)-2347] p 103 N87-28260  MARTINEZ, PEDRO A.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  MARTINOVIC, ZORAN N.  A comparison of active vibration control techniques - Output feedback vs optimal control [AIAA PAPER 87-0904] p 56 A87-33713  An analytical and experimental investigation of output feedback vs. linear quadratic regulator (AIAA PAPER 87-2390) p 61 A87-50474  MARUIZUMI, HARUKI  Evaluation testing of a mechanical actuator component operating in a simulated space environment p 160 A87-32549
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280 Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H.  Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R.  Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340  LOFLAND, WILLIAM W., JR.  An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784  LOFTUS, JOSEPH P.  Man's role in space exploration and exploitation p 169 A67-46332  LOGSDON, JOHN M.  Reconstituting the US space programme p 168 A87-41218  Priorities and policy analysis - A response to Alex Roland p 168 A87-41222  LOH, Y. C.  Antenna systems and RF coverage for the Space Station p 2 A87-45523  LONGHURST, F.  The Columbus system baseline and interfaces p 156 A87-53923  LONGMAN, R. W.  Dynamics during thrust maneuvers of flexible spinning satellites with axial and radial booms p 71 N87-25355  LORENZINI, ENRICO C.  A three-mass tethered system for micro-g/variable-g applications	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility  [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use p 147 A87-32546  MACHIDA, KAZUO  Development of harmonic drive actuator for space manipulator p 149 A87-35076  Development of a small-sized space manipulator p 101 A87-51979  MACKIW, G. E.  Multiple Access Ku-band communications subsystem for the Space Station p 84 A87-31462  MACKOWSKI, MAURA J.  Safety on the Space Station p 162 A87-35599  MAEKAWA, SHOJI  Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334  MALLA, RAMESH-BABU  Dynamic and thermal effects in very large space structures p 25 N87-20347  MALLARY, WILLIAM E.  Space Station data management system architecture p 111 A87-37293  MALLETTE, MICHAEL FREDERICK  Theory and application of linear servo dampers for large scale space structures p 72 N87-26970	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858  MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161  Concepts for space maintenance of OTV engines p 136 A87-46000  Concepts for space maintenance of OTV engines p 137 N87-26097  Service Manipulator Arm (SMA) for a Robotic Servicing Experiment (ROSE)  [ESA-CR(P)-2347] p 103 N87-28260  MARTINEZ, PEDRO A.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  MARTINOVIC, ZORAN N.  A comparison of active vibration control techniques - Output feedback vs optimal control  [AIAA PAPER 87-0904] p 56 A87-33713  An analytical and experimental investigation of output feedback vs. linear quadratic regulator  (AIAA PAPER 87-2390] p 61 A87-50474  MARUIZUMI, HARUKI  Evaluation testing of a mechanical actuator component operating in a simulated space environment  P 160 A87-32549  MASRI, SAMI F.  Evaluation of on-line pulse control for vibration suppression in flexible spacecraft  [NASA-CR-180391] p 70 N87-24513
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280 Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H.  Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R.  Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340  LOFLAND, WILLIAM W., JR.  An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784  LOFTUS, JOSEPH P.  Man's role in space exploration and exploitation p 169 A87-46332  LOGSDON, JOHN M.  Reconstituting the US space programme p 168 A87-41218  Priorities and policy analysis - A response to Alex Roland P 168 A87-41222  LOH, Y. C.  Antenna systems and RF coverage for the Space Station p 2 A87-45523  LONGHURST, F.  The Columbus system baseline and interfaces p 156 A87-53923  LONGMAN, R. W.  Dynamics during thrust maneuvers of flexible spinning satellities with axial and radial booms p 71 N87-25355  LORENZINI, ENRICO C.  A three-mass tethered system for micro-g/variable-g applications p 125 A87-40859  Analytical investigation of the dynamics of tethered constellations in Earth orbit, phase 2	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility  [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CAR R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use p 147 A87-32546  MACHIDA, KAZUO  Development of harmonic drive actuator for space manipulator p 149 A87-35076  Development of a small-sized space manipulator p 101 A87-51979  MACKIW, G. E.  Multiple Access Ku-band communications subsystem for the Space Station p 84 A87-31462  MACKOWSKI, MAURA J.  Safety on the Space Station p 162 A87-35599  MAEKAWA, SHOJI  Prediction of random vibrational responses of a large spacecraft in accustic environment by BLPF method p 144 A87-32334  MALLA, RAMESH-BABU  Dynamic and thermal effects in very large space structures p 25 N87-20347  MALLARY, WILLIAM E.  Space Station data management system architecture p 111 A87-37293  MALLETTE, MICHAEL FREDERICK  Theory and application of linear servo dampers for large scale space structures p 72 N87-26970  MAMODE, A.  Low frequency vibration testing on satellites	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858  MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161  Concepts for space maintenance of OTV engines p 136 A87-46000  Concepts for space maintenance of OTV engines p 137 N87-26097  Service Manipulator Arm (SMA) for a Robotic Servicing Experiment (ROSE) [ESA-CR(P)-2347] p 103 N87-28280  MARTINEZ, PEDRO A.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  MARTINOVIC, ZORAN N.  A comparison of active vibration control techniques - Output feedback vs optimal control [AIAA PAPER 87-2904] p 56 A87-33713  An analytical and experimental investigation of output feedback vs. linear quadratic regulator (AIAA PAPER 87-2390) p 61 A87-50474  MARUIZUMI, HARUKI  Evaluation testing of a mechanical actuator component operating in a simulated space environment  P 160 A87-32549  MASRI, SAMI F.  Evaluation of on-line pulse control for vibration suppression in flexible spacecraft [NASA-CR-180391] p 70 N87-24513
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280 Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H.  Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R.  Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340  LOFLAND, WILLIAM W., JR.  An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784  LOFTUS, JOSEPH P.  Man's role in space exploration and exploitation p 169 A87-46332  LOGSDON, JOHN M.  Reconstituting the US space programme p 168 A87-41218  Priorities and policy analysis - A response to Alex Roland p 168 A87-41222  LOH, Y. C.  Antenna systems and RF coverage for the Space Station p 2 A87-45523  LONGMURST, F.  The Columbus system baseline and interfaces p 156 A87-53923  LONGMAN, R. W.  Dynamics during thrust maneuvers of flexible spinning satellities with axial and radial booms p 71 N87-25355  LORENZINI, ENRICO C.  A three-mass tethered system for micro-g/variable-g applications p 125 A87-40859  Analytical investigation of the dynamics of tethered constellations in Earth orbit, phase 2  [NASA-CR-179149] p 130 N87-26083	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility  [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use p 147 A87-32546  MACHIDA, KAZUO  Development of harmonic drive actuator for space manipulator p 149 A87-35076  Development of a small-sized space manipulator p 101 A87-51979  MACKIW, G. E.  Multiple Access Ku-band communications subsystem for the Space Station p 84 A87-31462  MACKOWSKI, MAURA J.  Safety on the Space Station p 162 A87-35599  MAEKAWA, SHOJI  Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334  MALLA, RAMESH-BABU  Dynamic and thermal effects in very large space structures p 25 N87-20347  MALLARY, WILLIAM E.  Space Station data management system architecture p 111 A87-37293  MALLETTE, MICHAEL FREDERICK  Theory and application of linear servo dampers for large scale space structures p 72 N87-26970  MAMODE, A.  Low frequency vibration testing on satellites	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858  MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161  Concepts for space maintenance of OTV engines p 136 A87-46000  Concepts for space maintenance of OTV engines p 137 N87-26097  Service Manipulator Arm (SMA) for a Robotic Servicing Experiment (ROSE) [ESA-CR(P)-2347] p 103 N87-28260  MARTINEZ, PEDRO A.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  MARTINOVIC, ZORAN N.  A comparison of active vibration control techniques - Output feedback vs optimal control [AIAA PAPER 87-0904] p 56 A87-33713  An analytical and experimental investigation of output feedback vs. linear quadratic regulator (AIAA PAPER 87-2390] p 61 A87-50474  MARUIZUMI, HARUKI  Evaluation testing of a mechanical actuator component operating in a simulated space environment p 160 A87-32549  MASRI, SAMI F.  Evaluation of on-line pulse control for vibration suppression in flexible spacecraft [NASA-CR-180391] p 70 N87-24513  MASSEY, K.  Science Research Facilities - Versatility for Space
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280 Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H.  Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R.  Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340  LOFLAND, WILLIAM W., JR.  An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784  LOFTUS, JOSEPH P.  Man's role in space exploration and exploitation p 169 A87-46332  LOGSDON, JOHN M.  Reconstituting the US space programme p 168 A87-41218  Priorities and policy analysis - A response to Alex Roland p 168 A87-41222  LOH, Y. C.  Antenna systems and RF coverage for the Space Station p 2 A87-45523  LONGMURST, F.  The Columbus system baseline and interfaces p 156 A87-53923  LONGMAN, R. W.  Dynamics during thrust maneuvers of flexible spinning satellites with axial and radial booms p 71 N87-25355  LORENZINI, ENRICO C.  A three-mass tethered system for micro-g/variable-g applications p 125 A87-40859  Analytical investigation of the dynamics of tethered constellations in Earth orbit, phase 2 [NASA-CR-179149] p 130 N87-26083  LOSER, H. R.	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility  [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use p 147 A87-32546  MACHIDA, KAZUO  Development of harmonic drive actuator for space manipulator p 149 A87-35076  Development of a small-sized space manipulator p 101 A87-51979  MACKIW, G. E.  Multiple Access Ku-band communications subsystem for the Space Station p 84 A87-31462  MACKOWSKI, MAURA J.  Safety on the Space Station p 162 A87-35599  MAEKAWA, SHOJI  Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334  MALLA, RAMESH-BABU  Dynamic and thermal effects in very large space structures p 25 N87-20347  MALLARY, WILLIAM E.  Space Station data management system architecture p 111 A87-37293  MALLETTE, MICHAEL FREDERICK  Theory and application of linear servo dampers for large scale space structures p 72 N87-26970  MAMODE, A.  Low frequency vibration testing on satellites p 27 N87-20364  The high performance solar array GSR3	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858  MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161  Concepts for space maintenance of OTV engines p 136 A87-46000  Concepts for space maintenance of OTV engines p 137 N87-26097  Service Manipulator Arm (SMA) for a Robotic Servicing Experiment (ROSE) [ESA-CR(P)-2347] p 103 N87-28260  MARTINEZ, PEDRO A.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  MARTINOVIC, ZORAN N.  A comparison of active vibration control techniques - Output feedback vs optimal control [AIAA PAPER 87-0904] p 56 A87-33713  An analytical and experimental investigation of output feedback vs. linear quadratic regulator (AIAA PAPER 87-2390] p 61 A87-50474  MARUIZUMI, HARUKI  Evaluation testing of a mechanical actuator component operating in a simulated space environment  P 160 A87-32549  MASRI, SAMI F.  Evaluation of on-line pulse control for vibration suppression in flexible spacecraft [NASA-CR-180391] p 70 N87-24513  MASSEY, K.  Science Research Facilities - Versatility for Space
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280 Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H.  Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R.  Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340  LOFLAND, WILLIAM W., JR.  An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784  LOFTUS, JOSEPH P.  Man's role in space exploration and exploitation p 169 A87-46332  LOGSDON, JOHN M.  Reconstituting the US space programme p 168 A87-41218  Priorities and policy analysis - A response to Alex Roland p 168 A87-41222  LOH, Y. C.  Antenna systems and RF coverage for the Space Station p 2 A87-45523  LONGHURST, F.  The Columbus system baseline and interfaces p 156 A87-53923  LONGMAN, R. W.  Dynamics during thrust maneuvers of flexible spinning satellites with axial and radial booms p 71 N87-25355  LORENZINI, ENRICO C.  A three-mass tethered system for micro-g/variable-g applications in Earth orbit, phase 2  [NASA-CR-179149] p 130 N87-25031  LOSER, H. R.  Life Support Subsystem concepts for botanical	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use p 147 A87-32546  MACHIDA, KAZUO  Development of harmonic drive actuator for space manipulator p 149 A87-35076  Development of a small-sized space manipulator p 101 A87-51979  MACKIW, G. E.  Multiple Access Ku-band communications subsystem for the Space Station p 84 A87-31462  MACKOWSKI, MAURA J.  Safety on the Space Station p 162 A87-35599  MAEKAWA, SHOJI  Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334  MALLA, RAMESH-BABU  Dynamic and thermal effects in very large space structures p 25 N87-20347  MALLARY, WILLIAM E.  Space Station data management system architecture p 111 A87-37293  MALLETTE, MICHAEL FREDERICK  Theory and application of linear servo dampers for large scale space structures p 72 N87-26970  MAMODE, A.  Low frequency vibration testing on satellites p 27 N87-20364  The high performance solar array GSR3 p 81 N87-28972	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858  MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161  Concepts for space maintenance of OTV engines p 136 A87-46000  Concepts for space maintenance of OTV engines p 137 N87-26097  Service Manipulator Arm (SMA) for a Robotic Servicing Experiment (ROSE) [ESA-CR(P)-2347] p 103 N87-28260  MARTINEZ, PEDRO A.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  MARTINOVIC, ZORAN N.  A comparison of active vibration control techniques - Output feedback vs optimal control [AIAA PAPER 87-0904] p 56 A87-33713  An analytical and experimental investigation of output feedback vs. linear quadratic regulator (AIAA PAPER 87-2390) p 61 A87-50474  MARUIZUMI, HARUKI  Evaluation testing of a mechanical actuator component operating in a simulated space environment p 160 A87-32549  MASRI, SAMI F.  Evaluation of on-line pulse control for vibration suppression in flexible spacecraft [NASA-CR-180391] p 70 N87-24513  MASSEY, K.  Science Research Facilities - Versatility for Space Station  [SAE PAPER 860958] p 119 A87-38742
Spacecraft ram glow and surface temperature p 10 N87-26205  LODGE, D. W. S.  British activities in space p 143 A87-32280 Design of a polar platform with an earth observation payload p 122 A87-32538  LOESER, H.  Life support subsystem concepts for botanical experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967  LOESER, HELMUT R.  Botanical payloads for platforms and space stations [MBB-UR-E-921/86] p 158 N87-25340  LOFLAND, WILLIAM W., JR.  An improved waste collection system for space flight [SAE PAPER 861014] p 119 A87-38784  LOFTUS, JOSEPH P.  Man's role in space exploration and exploitation p 169 A87-46332  LOGSDON, JOHN M.  Reconstituting the US space programme p 168 A87-41218  Priorities and policy analysis - A response to Alex Roland p 168 A87-41222  LOH, Y. C.  Antenna systems and RF coverage for the Space Station p 2 A87-45523  LONGMURST, F.  The Columbus system baseline and interfaces p 156 A87-53923  LONGMAN, R. W.  Dynamics during thrust maneuvers of flexible spinning satellites with axial and radial booms p 71 N87-25355  LORENZINI, ENRICO C.  A three-mass tethered system for micro-g/variable-g applications p 125 A87-40859  Analytical investigation of the dynamics of tethered constellations in Earth orbit, phase 2 [NASA-CR-179149] p 130 N87-26083  LOSER, H. R.	MA, PAUL T.  External contamination environment of Space Station Customer Servicing Facility  [AIAA PAPER 87-1623] p 52 A87-43122  MAAG, CARL R.  Design considerations for long-lived glass mirrors for space p 123 A87-36531  MACHIDA, K.  Study of actuator for large space manipulator arm p 12 A87-32545  A master-slave manipulator system for space use p 147 A87-32546  MACHIDA, KAZUO  Development of harmonic drive actuator for space manipulator p 149 A87-35076  Development of a small-sized space manipulator p 101 A87-51979  MACKIW, G. E.  Multiple Access Ku-band communications subsystem for the Space Station p 84 A87-31462  MACKOWSKI, MAURA J.  Safety on the Space Station p 162 A87-35599  MAEKAWA, SHOJI  Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method p 144 A87-32334  MALLA, RAMESH-BABU  Dynamic and thermal effects in very large space structures p 25 N87-20347  MALLARY, WILLIAM E.  Space Station data management system architecture p 111 A87-37293  MALLETTE, MICHAEL FREDERICK  Theory and application of linear servo dampers for large scale space structures p 72 N87-26970  MAMODE, A.  Low frequency vibration testing on satellites p 27 N87-20364  The high performance solar array GSR3	MARTIN, JOHN  Mass storage systems for data transport in the early space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443  MARTIN, R. A.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  MARTINEZ-SANCHEZ, MANUEL  Orbital modifications using forced tether-length variations p 124 A87-40858  MARTINEZ, A.  Concepts for space maintenance of OTV engines p 135 A87-41161  Concepts for space maintenance of OTV engines p 136 A87-46000  Concepts for space maintenance of OTV engines p 137 N87-26097  Service Manipulator Arm (SMA) for a Robotic Servicing Experiment (ROSE) [ESA-CR(P)-2347] p 103 N87-28260  MARTINEZ, PEDRO A.  Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294  MARTINOVIC, ZORAN N.  A comparison of active vibration control techniques - Output feedback vs. pitmal control [AIAA PAPER 87-0904] p 56 A87-33713  An analytical and experimental investigation of output feedback vs. pitmaer quadratic regulator (AIAA PAPER 87-2390] p 61 A87-50474  MARUIZUMI, HARUKI  Evaluation testing of a mechanical actuator component operating in a simulated space environment p 160 A87-32549  MASRI, SAMI F.  Evaluation of on-line pulse control for vibration suppression in flexible spacecraft [NASA-CR-180391] p 70 N87-24513  MASSEY, K.  Science Research Facilities - Versatility for Space Station [SAE PAPER 860958] p 119 A87-38742

On the performance analysis of a real-time distributed On the performance and particles of the space 'monorail'
p 148 A87-34047

radar

MATSUDA, HIROAKI

A thermally-pumped heat transport system

p 145 A87-32507

p 40 A87-32369

LOTTA, JOSEPH G.

versus graphite epoxy [SAWE PAPER 1692]

p 20 A87-36279

Comparison of satellite support structure aluminum

PERSONAL AUTHOR INDE	EX	
MATSUMOTO, K.		
Japanese space information sys		
[AIAA PAPER 87-2191] MATSUMOTO, KOHTARO	p 153	A87-4857
An enclosed hangar concept	for large	spacecra
servicing at Space Station MATSUMURA, HIROYUKI	p 146	A87-3253
Preliminary experimental study or	the oxyg	en separatir
and concentrating system for CELS  Development of carbon diox	SS p.46 ide remo	A87-3245
Experimental study of solid amines	p 145	A87-3245
MATSUO, HIROKI International Symposium on Sp	ace Tech	nology an
Science, 15th, Tokyo, Japan,	May 1	9-23, 198
Proceedings. Volumes 1 & 2 MATSUZAKI, SATOSHI	p 166	A87-3227
Automatic generation of stochas		
modes for large-scale structures MAZENKO, D. M.	p 149	A87-3785
Joint technology for graphite epo		
MAZZA, C.	p 20	A87-3860
Data management standards systems	for space	informatio
[AIAA PAPER 87-2205]	p 113	A87-4859
ESA software engineering s programmes	tandards	for futur
[AIAA PAPER 87-2207]	p 154	A87-4859
MCCALEB, FRED Data storage systems technology	for the C	nana Statia
era	TOT THE S	pace Statio
[AIAA PAPER 87-2202] Mass storage systems for data	p 113	A87-4858
space station era 1992-1998		III LIIG GAIL
[NASA-TM-87826] MCCANNEY, J. M.	p 115	N87-2744
CP/MPS - Contained plasma r	nagnetic	propulsion
system: An advanced propulsion co [AIAA PAPER 87-1042]		A87-3801
MCCLURE, JOHN W.		
A comparison of scheduling algor management of the Space Sta	ithms for tion elec	autonomou: :tric enero
system		
[AIAA PAPER 87-2467] MCCORMACK, PERCIVAL D.	p //	A87-5051
Radiation dose prediction for Spa		
[SAE PAPER 860924] ACCORMICK, P. J.	p 139	A87-38715
Joint technology for graphite epor		
ACCOY, JAMES E.	p 20	A87-38600
Electrodynamic plasma motor/ [AAS PAPER 86-210]	generator	experiment
Plasma motor/generator reference	e system	A87-38569 designs for
power and propulsion [AAS PAPER 86-229]	n 90	A97 20572
ICCREIGHT, LOUIS R.		A87-38572
Computerized aerospace materia of the Workshop on Computerized P	is data; F	Proceedings
Design Data for the Aerospace Indus	stry, El Se	gundo, CA,
June 23-25, 1986 ICCUTCHEN, DON K.	p 111	A87-35282
Dynamic and attitude control of	character	istics of an
International Space Station [AIAA PAPER 87-0931]		A87-33731
ICDONALD, FRANK B.	F 0.	
Space research - At a crossroads	p 166	A87-32017
CDONOUGH, THOMAS R.		
Space the next twenty-five years	p 168	A87-44375

Space Station life support oxygen generation by SPE water electrolyzer systems [SAE PAPER 860949] p 49 A87-38736 MCEVER, W. S. High thermal capacity evaporator and condensers for Space Station thermal control p 41 A87-32377 MCGOWAN, DAVID M. Experimental evaluation of small-scale erectable truss hardware NASA-TM-890681 p 37 N87-26085 MCGOWAN PAUL F Effects of local vibrations on the dynamics of space truss structures

Considerations in the design and development of a

COFS 3 multibody dynamics and control technology

Aromatic polyester polysiloxane block copolymers:

Space Station gas-grain simulation facility - Application

Multiphase transparent damping materials

p 17 A87-33739

p 9 N87-22711

p 69 N87-24506

p 110 N87-27809

p 127 A87-53002

**[AIAA PAPER 87-0941]** 

MCGRATH, JAMES E.

[AD-A182623]

MCKAY, C. P.

to exobiology

space station scale model

MCKNIGHT, DARREN SCOTT 79 34 control 32 spacecraft 00 าก ю MÈLL, R. J. MENDE, S. B. [SPIE-644]

MEISL, CLAUS

Simulation of on-orbit satellite fragmentations p 140 N87-24515 MCLAREN, M. D. Robust multivariable control of large space structures p 59 A87-47810 Construction of positive real compensation for LSS [AIAA PAPER 87-2238] p 60 A87-50404 MCMILLAN, R. S. Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222 MEACHAM, S. A. The Oak Ridge National Laboratory's Robotics and Intelligent Systems Program [DE87-004627] p 101 N87-20774 MEIROVITCH, L. Equations of motion for maneuvering flexible p 63 A87-52965 Maneuvering and vibration control of flexible pacecraft p 67 N87-22734 MEIROVITCH, LEONARD Sensitivity of distributed structures to model order in feedback control [AIAA PAPER 87-0900] p 56 A87-33710 Some problems in the control of large space [AD-A1799891 p 70 N87-25350 MEIROVITCHT, L. Control of distributed structures with small nonproportional damping [AIAA PAPER 87-2250] p 60 A87-50414 Density uncertainty effect on cost of space station p 170 N87-20667 The Radarsat Modular Opto-electronic Multispectral Scanner (R-MOMS): A potential candidate for the Polar Orbiting Platform (POP) also [MBB-UR-873/86] p 130 N87-25506 Space stable thermal control coatings [AD-A182796] p 110 N87-28584 Spacecraft ram glow and surface temperature p 10 N87-26205 MENEES, GENE P. Synergetic plane-change capability of a conceptual aeromaneuvering-orbital-transfer vehicle [AIAA PAPER 87-2565] p 92 A87-49615 MENG, PHILLIP R. Space station propulsion system technology [NASA-TM-100108] p 97 N87-25422 MENNING, MIKE D. Test results from the solar array flight experiment p 83 N87-29010 MENZIES, ROBERT T. Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 p 125 A87-44176 MERCADAL, MATHIEU Joint nonlinearity effects in the design of a flexible truss structure control system

[NASA-CR-180633] MERCANTI, ENRICO LEO and GEO missions MERTESDORF, S. J. spacecraft thermal management [AIAA PAPER 87-1482] MESEROLE, JERE S. [AIAA PAPER 87-2018] Overview: Fluid acquisition and transfer condensation MESHISHNEK, M. J. [AD-A1829311 MESSIDORO, P. satellite [SAE PAPER 860939] METTLER, E.

p 37 N87-26365 p 5 N87-29916 Low frequency vibration testing on satellites p 27 N87-20364 The benefit of phase change thermal storage for p 43 A87-43014 Mixing-induced ullage condensation and fluid p 92 A87-45357 p 94 N87-21146 Mixing-induced fluid destratification and ullage pndensation p 95 N87-21149 Effects on advanced materials: Results of the STS-8 EOIM (Effects of Oxygen Interaction with Materials) p 110 N87-29709 Infrared test technique validation on the Olympus p 150 A87-38728 Antenna Technology Shuttle Experiment (ATSE) p 87 N87-24508 METZDORF, J. Absolute indoor calibration of large area solar cells p 159 N87-29015

MINGORI, D. L. METZINGER, R. W. An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672] p 100 A87-41152 MEYA, ROBERT D. 1987 status report - United States Air Force electric propulsion research and development [AIAA PAPER 87-1036] p 90 A87-41122 MEYER, D. PAUL Space Station EVA using a maneuvering enclosure unit [SAE PAPER 861010] p 135 A87-38782 MICHAL, R. J. Fiber-optic monitors for space structures p 11 A87-31505 MICHAUD, ROGER B. Conceptual planning for Space Station life sciences human research project [SAE PAPER 860969] p 164 A87-38751 Concepts for the evolution of the Space Station Program [SAE PAPER 860972] p 120 A87-38754 MIELE, A. Optimal trajectories for aeroassisted, coplanar orbital transfer p 54 A87-31681 MIELKE, MICHAEL Preliminary analysis of a prototype space solar power IILR-MITT-1681 p 79 N87-24532 MIGRA, ROBERT P. Microgravity fluid management requirements of advanced solar dynamic power systems p 77 N87-21153 MIKULAS, MARTIN M., JR. Design, construction, and utilization of a space station assembled from 5-meter erectable struts p 34 N87-24501 Deployable geodesic truss structure IASA-CASE-I AR-12442 41 [NASA-CASE-LAR-13113-1] p 36 N87-25492 Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 103 N87-29118 MILDICE, J. W. Control considerations for high frequency, resonant, power processing equipment used in large systems [NASA-TM-89926] p 68 N87-23690 MILES, WILLIAM L. Habitation module for the Space Station [SAE PAPER 860928] p 163 A87-38718 MILLER, C. W. Integrated air revitalization system for Space Station [SAE PAPER 860946] p 48 A87-38733 MILLER, CRAIG W. Environmental Control Life Support for the Space Station [SAE PAPER 860944] p 48 A87-38731 MILLER, D. P. A two-dimensional numerical heat transfer model for a solar propulsion system p 74 A87-32306 MILLER, DANA SOT: A rapid prototype using TAE windows p 114 N87-23161 MILLER, DAVID F. Gradient-based combined structural and control ptimization p 21 A87-40866 Development of intelligent structures using finite control elements in a hierarchic and distributed control system p 72 N87-25805

MILLER, DAVID W.

[AD-A179711]

Antenna Technology Shuttle Experiment (ATSE) p 87 N87-24508

MILLER, LADONNA J. Conceptual planning for Space Station life sciences human research project

[SAE PAPER 860969] p 164 A87-38751 Concepts for the evolution of the Space Station Program [SAE PAPER 860972] p 120 A87-38754 MILLER, RICHARD K.

Structural concepts for large solar concentrators [NASA-CR-4075] p 65 N87-21994 MILLIN, NICOLAUS Preliminary analysis of a prototype space solar power

(ILR-MITT-168) MINEMOTO, M.

Concept study of regenerable carbon dioxide removal and oxygen recovery system for the Space Station p 46 A87-32544

MINGORI, D. L. Robust controller design using frequency domain constraints

Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic circulatory forces p 22 A87-47812

Development of fluid loop system for spacecraft p 144 A87-32370

System and operation analyses of OTV Network - A

new space transportation concept p 145 A87-32475

NAKAMURA, YOSHIHIRO
Solar concentrator system for experiments in the Space p 146 A87-32595

NAKASUKA, SINICHI

MINODA, YOSHIO	MOORE, E. A.	MUEHLBAUER, K.
Development of metal matrix composites in R & D	Common drive unit p 104 N87-29869	Spacecraft qualification using advanced vibration and
Institute of Metals & Composites for Future Industries	MOORMAN, GERARD J.	modal testing techniques p 27 N87-20368
p 107 A87-51772	Real-time simulation for Space Station	MUFTI, I. H.
MINOMO, MASAHIRO	p 7 A87-37298	Model reference adaptive control for large structural
On-board K- and S-band multi-beam antennas	MORASKO, GWYNDOLYN	0,0.0
p 86 A87-46281	Air Evaporation closed cycle water recovery technology	MUIR, ARTHUR H., JR.
MIRTICH, MICHAEL	- Advanced energy saving designs	Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306
An evaluation of candidate oxidation resistant	[SAE PAPER 860987] p 51 A87-38766	
materials p 110 N87-26203	MOREL, A.	MUKERJEE, AMITABHA
MIRTICH, MICHAEL J.	Ocean-ice panel report p 156 N87-20635	Self-calibration strategies for robot manipulators p 102 N87-26355
Oxidation protection coatings for polymers	MORGAN, ERIC L.	•
[NASA-CASE-LEW-14072-3] p 107 N87-23736	Proposed application of automated biomonitoring for	MURAKAMI, MASAAKI A thermally-pumped heat transport system
MITANI, KENJI	rapid detection of toxic substances in water supplies for	p 40 A87-32369
Water recycling for Space Station p 46 A87-32459	permanent space stations p 164 A87-40098	MURATORE, J.
MITCHELL, J. R.	MORGANTI, F.	Space Station Information System integrated
One Controller at a Time (1-CAT): A mimo design	Evaluation of the built-in stresses and residual distortions	communications concept
methodology p 65 N87-22715	on cured composites for space antenna reflectors	[AIAA PAPER 87-2228] p 114 A87-48606
MITROKA, GEORGE D.	applications p 22 A87-47327	Space Station Information System requirements for
Suboptimal control of large flexible space structures	MORI, KINJI	integrated communications
experiencing rotational dynamics nonlinearities	Autonomous decentralized system concept for Space	[AIAA PAPER 87-2229] p 114 A87-48607
[AD-A180606] p 71 N87-25352	Station p 146 A87-32541	MUROTSU, Y.
MITSUMA, HIDEHIDO		Low-authority control of large space structures by using
Structural design and component tests of large	MORI, TADAHISA  Japan's space development programs for	tendon control system
geostationary satellite bus p 144 A87-32335	communications - An overview p 152 A87-43156	[AIAA PAPER 87-2249] p 60 A87-50413
MITSUMA, HIDEHIKO		MUROTSU, YOSHISADA
Prediction of random vibrational responses of a large	MORIAI, T.  Development of the electrical power subsystem for the	Automatic generation of stochastically dominant failure
spacecraft in acoustic environment by BLPF method	electric propulsion experiment onboard the Space Flyer	modes for large-scale structures p 149 A87-37853
p 144 A87-32334	Unit (SFU)	MURPHY, GEORGE L.
MIURA, K.	[AIAA PAPER 87-1040] p 76 A87-39628	Space Station galley design
Design consideration of mechanical and deployment properties of a coilable lattice mast p 12 A87-32340	Development of control and monitor subsystem for	[SAE PAPER 860932] p 119 A87-38722
p. op o	electric propulsion experiment onboard Space Flyer Unit	MURRAY, J.
MiURA, KORYO  Model study of simplex masts p 144 A87-32339		Space station structural dynamics/reaction control
Model study of simplex masts p 144 A87-32339 Deployable surface truss concepts and two-dimensional	(SFU) [AIAA PAPER 87-1041] p 76 A87-39629	system interaction study p 67 N87-22753
adaptive structures p 144 A87-32341	C	MURRAY, N. D.
MOCCIA, A.	MORISHITA, Y.	Information network architectures p 116 N87-29149
The Tethered Satellite System as a new remote sensing	Status of Japanese Experiment Module design	Video image processing p 116 N87-29150
platform p 124 A87-39183	•	MURRAY, R. F.
MODI, V. J.	MOROSOW, G.  Benefits of passive damping as applied to active control	Electronic control/display interface technology p 88 N87-29161
Transient dynamics of orbiting flexible structural	of large space structures p 63 N87-20371	•
members p 54 A87-32338	MOROZOV, A. I.	MURRAY, R. W. Integrated waste and water management system
Deployment dynamics of space structures	Instability of an elastic filament in orbit around a	[SAE PAPER 860996] p 51 A87-38773
p 58 A87-40074	gravitating center p 148 A87-32815	,
A formulation for studying dynamics of N connected	Critical length for stable elongated orbiting structures	MYRON, D. L.  Development of a prototype two-phase thermal bus
flexible deployable members p 21 A87-41574	p 148 A87-32819	system for Space Station
A formulation for studying steady state/transient dynamics of a large class of spacecraft and its	MORREN, W. EARL	[AIAA PAPER 87-1628] p 44 A87-43126
	Preliminary performance characterizations of an	[/m/stream = trees]
application p 35 N87-25357  MOE. KAREN L.	engineering model multipropellant resistojet for space	<b>A.</b>
Standards for the user interface - Developing a user	station application	N
		• •
CORPORATE	[AIAA PAPER 87-2120] p 93 A87-50197	
consensus [AIAA PAPER 87-2209] p 169 A87-48594		NAGATOMO, MAKOTO
[AIAA PAPER 87-2209] p 169 A87-48594	[AIAA PAPER 87-2120] p 93 A87-50197	
[AIAA PAPER 87-2209] p 169 A87-48594 MOFFATT, MILES	[AIAA PÁPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237	NAGATOMO, MAKOTO
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES  The development of an EVA Universal Work Station	[AIAA PÁPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an	NAGATOMO, MAKOTO  Concept design and cost estimation of a free-flying space platform p 146 A87-32539
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES  The development of an EVA Universal Work Station	[AIAA PÁPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237	NAGATOMO, MAKOTO  Concept design and cost estimation of a free-flying
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739	[AIAA PAPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application	NAGATOMO, MAKOTO  Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J.  Wave-mode coordinates and scattering matrices for wave propagation
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHR, SATOSHI	[AIAA PÁPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821	NAGATOMO, MAKOTO  Concept design and cost estimation of a free-flying space platform p 146 A87-32539 NAGEM, RAYMOND J.  Wave-mode coordinates and scattering matrices for
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHRI, SATOSHI Autonomous decentralized system concept for Space	[AIAA PAPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821 Water-propellant resistojets for man-tended platforms	NAGATOMO, MAKOTO  Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J.  Wave-mode coordinates and scattering matrices for wave propagation
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHR, SATOSHI	[AIAA PAPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821 Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135	NAGATOMO, MAKOTO  Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J.  Wave-mode coordinates and scattering matrices for wave propagation [AD-A176998] p 29 N87-21030  Comparison of wave-mode coordinate and pulse summation methods
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHRI, SATOSHI Autonomous decentralized system concept for Space Station p 146 A87-32541  MONACO, C.	[AIAA PÁPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821 Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135 MORRIS, EDGAR E.	NAGATOMO, MAKOTO  Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J.  Wave-mode coordinates and scattering matrices for wave propagation  [AD-A176998] p 29 N87-21030  Comparison of wave-mode coordinate and pulse summation methods  [AD-A177795] p 30 N87-21992
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHRI, SATOSHI Autonomous decentralized system concept for Space Station p 146 A87-32541  MONACO, C. Data management system architecture options for space	[AIAA PÁPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821 Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135  MORRIS, EDGAR E. Composite fiber/metal Space Station tankage -	NAGATOMO, MAKOTO Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J. Wave-mode coordinates and scattering matrices for wave propagation [AD-A176998] p 29 N87-21030 Comparison of wave-mode coordinate and pulse summation methods [AD-A177795] p 30 N87-21992 Wave propagation in transversely isotropic continuum
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHRI, SATOSHI Autonomous decentralized system concept for Space Station p 146 A87-32541  MONACO, C. Data management system architecture options for space stations	[AIAA PÁPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821 Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135 MORRIS, EDGAR E. Composite fiber/metal Space Station tankage - Applications, material/process/design trades, and	NAGATOMO, MAKOTO Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J. Wave-mode coordinates and scattering matrices for wave propagation [AD-A176998] p 29 N87-21030 Comparison of wave-mode coordinate and pulse summation methods [AD-A177795] p 30 N87-21992 Wave propagation in transversely isotropic continuum models of LSS (Large Space Structures)
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHRI, SATOSHI Autonomous decentralized system concept for Space Station MONACO, C. Data management system architecture options for space stations [SES/DNP/TR/002/85] p 115 N87-28585	[AIAA PAPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821 Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135  MORRIS, EDGAR E. Composite fiber/metal Space Station tankage - Applications, material/process/design trades, and subscale manufacturing/test results	NAGATOMO, MAKOTO  Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J.  Wave-mode coordinates and scattering matrices for wave propagation  [AD-A176998] p 29 N87-21030  Comparison of wave-mode coordinate and pulse summation methods  [AD-A177795] p 30 N87-21992
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHRI, SATOSHI Autonomous decentralized system concept for Space Station p 146 A87-32541  MONACO, C. Data management system architecture options for space stations [SES/DNP/TR/002/85] p 115 N87-28585  MONACO, S.	[AIAA PÁPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821 Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135  MORRIS, EDGAR E. Composite fiber/metal Space Station tankage - Applications, material/process/design trades, and subscale manufacturing/test results [AIAA PAPER 87-2157] p 160 A87-45441	NAGATOMO, MAKOTO  Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J.  Wave-mode coordinates and scattering matrices for wave propagation  [AD-A176998] p 29 N87-21030  Comparison of wave-mode coordinate and pulse summation methods  [AD-A177795] p 30 N87-21992  Wave propagation in transversely isotropic continuum models of LSS (Large Space Structures)  [AD-A177271] p 30 N87-22256  NAIDU, D. S.
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHRI, SATOSHI Autonomous decentralized system concept for Space Station p 146 A87-32541  MONACO, C. Data management system architecture options for space stations [SES/DNP/TR/002/85] p 115 N87-28585  MONACO, S. Sampled nonlinear control for large angle space systems	[AIAA PÁPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821 Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135 MORRIS, EDGAR E. Composite fiber/metal Space Station tankage - Applications, material/process/design trades, and subscale manufacturing/test results [AIAA PAPER 87-2157] p 160 A87-45441 MORRIS, J.	NAGATOMO, MAKOTO Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J. Wave-mode coordinates and scattering matrices for wave propagation [AD-A176998] p 29 N87-21030 Comparison of wave-mode coordinate and pulse summation methods [AD-A177795] p 30 N87-21992 Wave propagation in transversely isotropic continuum models of LSS (Large Space Structures) [AD-A177271] p 30 N87-22256  NAIDU, D. S. Experience in distributed parameter modeling of the
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHRI, SATOSHI Autonomous decentralized system concept for Space Station p 146 A87-32541  MONACO, C. Data management system architecture options for space stations [SES/DNP/TR/002/85] p 115 N87-28585  MONACO, S. Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358	[AIAA PAPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821 Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135  MORRIS, EDGAR E. Composite fiber/metal Space Station tankage - Applications, material/process/design trades, and subscale manufacturing/test results [AIAA PAPER 87-2157] p 160 A87-45441  MORRIS, J. Space Station gas-grain simulation facility - Applications	NAGATOMO, MAKOTO  Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J.  Wave-mode coordinates and scattering matrices for wave propagation  [AD-A176998] p 29 N87-21030  Comparison of wave-mode coordinate and pulse summation methods  [AD-A177795] p 30 N87-21992  Wave propagation in transversely isotropic continuum models of LSS (Large Space Structures)  [AD-A177271] p 30 N87-22256  NAIDU, D. S.
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHRI, SATOSHI Autonomous decentralized system concept for Space Station p 146 A87-32541  MONACO, C. Data management system architecture options for space stations [SES/DNP/TR/002/85] p 115 N87-28585  MONACO, S. Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358	[AIAA PÁPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821 Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135  MORRIS, EDGAR E. Composite fiber/metal Space Station tankage - Applications, material/process/design trades, and subscale manufacturing/test results [AIAA PAPER 87-2157] p 160 A87-45441  MORRIS, L  Space Station gas-grain simulation facility - Application to exobiology p 127 A87-53002	NAGATOMO, MAKOTO Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J. Wave-mode coordinates and scattering matrices for wave propagation [AD-A176998] p 29 N87-21030 Comparison of wave-mode coordinate and pulse summation methods [AD-A177795] p 30 N87-21992 Wave propagation in transversely isotropic continuum models of LSS (Large Space Structures) [AD-A177271] p 30 N87-22256  NAIDU, D. S. Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE)
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHRI, SATOSHI Autonomous decentralized system concept for Space Station p 146 A87-32541  MONACO, C. Data management system architecture options for space stations [SES/DNP/TR/002/85] p 115 N87-28585  MONACO, S. Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  MONSON, CONRAD B. Physiological aspects of EVA	[AIAA PÁPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821 Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135 MORRIS, EDGAR E. Composite fiber/metal Space Station tankage - Applications, material/process/design trades, and subscale manufacturing/test results [AIAA PAPER 87-2157] p 160 A87-45441 MORRIS, J. Space Station gas-grain simulation facility - Application to exobiology MORSE, T. W.	NAGATOMO, MAKOTO Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J. Wave-mode coordinates and scattering matrices for wave propagation [AD-A176898] p 29 N87-21030 Comparison of wave-mode coordinate and pulse summation methods [AD-A177795] p 30 N87-21992 Wave propagation in transversely isotropic continuum models of LSS (Large Space Structures) [AD-A177271] p 30 N87-22256  NAIDU, D. S. Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE)
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHRI, SATOSHI Autonomous decentralized system concept for Space Station p 146 A87-32541  MONACO, C. Data management system architecture options for space stations [SES/DNP/TR/002/85] p 115 N87-28585  MONACO, S. Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  MONSON, CONRAD B. Physiological aspects of EVA [SAE PAPER 860991] p 164 A87-38768	[AIAA PÁPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821 Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135  MORRIS, EDGAR E. Composite fiber/metal Space Station tankage - Applications, material/process/design trades, and subscale manufacturing/test results [AIAA PAPER 87-2157] p 160 A87-45441  MORRIS, L  Space Station gas-grain simulation facility - Application to exobiology p 127 A87-53002	NAGATOMO, MAKOTO Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J. Wave-mode coordinates and scattering matrices for wave propagation [AD-A176998] p 29 N87-21030 Comparison of wave-mode coordinate and pulse summation methods [AD-A177795] p 30 N87-21992 Wave propagation in transversely isotropic continuum models of LSS (Large Space Structures) [AD-A177271] p 30 N87-22256  NAIDU, D. S. Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE) structure [AIAA PAPER 87-0895] p 16 A87-33689
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHRI, SATOSHI Autonomous decentralized system concept for Space Station p 146 A87-32541  MONACO, C. Data management system architecture options for space stations [SES/DNP/TR/002/85] p 115 N87-28585  MONACO, S. Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  MONSON, CONRAD B. Physiological aspects of EVA [SAE PAPER 860991] p 164 A87-38768	[AIAA PÁPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821 Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135  MORRIS, EDGAR E. Composite fiber/metal Space Station tankage - Applications, material/process/design trades, and subscale manufacturing/test results [AIAA PAPER 87-2157] p 160 A87-45441  MORRIS, J. Space Station gas-grain simulation facility - Application to exobiology p 127 A87-53002  MORSE, T. W. High speed simulation of multi-flexible-body systems with large rotations	NAGATOMO, MAKOTO Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J. Wave-mode coordinates and scattering matrices for wave propagation [AD-A176998] p 29 N87-21030 Comparison of wave-mode coordinate and pulse summation methods [AD-A177795] p 30 N87-21992 Wave propagation in transversely isotropic continuum models of LSS (Large Space Structures) [AD-A177271] p 30 N87-22256  NAIDU, D. S. Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE) structure [AIAA PAPER 87-0895] p 16 A87-33689  NAKAGAWA, J. A master-slave manipulator system for space use
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHRI, SATOSHI Autonomous decentralized system concept for Space Station p 146 A87-32541  MONACO, C. Data management system architecture options for space stations [SES/DNP/TR/002/85] p 115 N87-28585  MONACO, S. Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  MONSON, CONRAD B. Physiological aspects of EVA [SAE PAPER 860991] p 164 A87-38768	[AIAA PÁPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821 Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135 MORRIS, EDGAR E. Composite fiber/metal Space Station tankage - Applications, material/process/design trades, and subscale manufacturing/test results [AIAA PAPER 87-2157] p 160 A87-45441 MORRIS, J. Space Station gas-grain simulation facility - Application to exobiology MORSE, T. W. High speed simulation of multi-flexible-body systems with large rotations [AIAA PAPER 87-0930] p 57 A87-33730	NAGATOMO, MAKOTO Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J. Wave-mode coordinates and scattering matrices for wave propagation [AD-A176998] p 29 N87-21030 Comparison of wave-mode coordinate and pulse summation methods [AD-A177795] p 30 N87-21992 Wave propagation in transversely isotropic continuum models of LSS (Large Space Structures) [AD-A177271] p 30 N87-22256  NAIDU, D. S. Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE) structure [AIAA PAPER 87-0895] p 16 A87-33689
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHRI, SATOSHI Autonomous decentralized system concept for Space Station p 146 A87-32541  MONACO, C. Data management system architecture options for space stations [SES/DNP/TR/002/85] p 115 N87-28585  MONACO, S. Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  MONSON, CONRAD B. Physiological aspects of EVA [SAE PAPER 860991] p 164 A87-38768  MONTE, PAUL A. Geostationary platforms - An international perspective p 121 A87-32288	[AIAA PÁPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821 Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135  MORRIS, EDGAR E. Composite fiber/metal Space Station tankage - Applications, material/process/design trades, and subscale manufacturing/test results [AIAA PAPER 87-2157] p 160 A87-45441  MORRIS, J. Space Station gas-grain simulation facility - Application to exobiology p 127 A87-53002  MORSE, T. W. High speed simulation of multi-flexible-body systems with large rotations [AIAA PAPER 87-0930] p 57 A87-33730  MORTENSEN, A. J. Progress on the Ohio State University Get Away Special	NAGATOMO, MAKOTO Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J. Wave-mode coordinates and scattering matrices for wave propagation [AD-A176998] p 29 N87-21030 Comparison of wave-mode coordinate and pulse summation methods [AD-A177795] p 30 N87-21992 Wave propagation in transversely isotropic continuum models of LSS (Large Space Structures) [AD-A177271] p 30 N87-22256  NAIDU, D. S. Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE) structure [AIAA PAPER 87-0895] p 16 A87-33689  NAKAGAWA, J. A master-slave manipulator system for space use p 147 A87-32546
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHRI, SATOSHI Autonomous decentralized system concept for Space Station p 146 A87-32541  MONACO, C. Data management system architecture options for space stations [SES/DNP/TR/002/85] p 115 N87-28585  MONACO, S. Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  MONSON, CONRAD B. Physiological aspects of EVA [SAE PAPER 860991] p 164 A87-38768  MONTE, PAUL A. Geostationary platforms - An international perspective p 121 A87-32288	[AIAA PÁPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821 Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135  MORRIS, EDGAR E. Composite fiber/metal Space Station tankage - Applications, material/process/design trades, and subscale manufacturing/test results [AIAA PAPER 87-2157] p 160 A87-45441  MORRIS, J. Space Station gas-grain simulation facility - Application to exobiology  MORSE, T. W. High speed simulation of multi-flexible-body systems with large rotations [AIAA PAPER 87-0930] p 57 A87-33730  MORTENSEN, A. J.	NAGATOMO, MAKOTO Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J. Wave-mode coordinates and scattering matrices for wave propagation [AD-A176998] p 29 N87-21030 Comparison of wave-mode coordinate and pulse summation methods [AD-A177795] p 30 N87-21992 Wave propagation in transversely isotropic continuum models of LSS (Large Space Structures) [AD-A177271] p 30 N87-22256  NAIDU, D. S. Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE) structure [AIAA PAPER 87-0895] p 16 A87-33689  NAKAGAWA, J. A master-slave manipulator system for space use p 147 A87-32546  NAKAJIMA, TAKASHI Concept design and cost estimation of a free-flying
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHRI, SATOSHI Autonomous decentralized system concept for Space Station p 146 A87-32541  MONACO, C. Data management system architecture options for space stations [SES/DNP/TR/002/85] p 115 N87-28585  MONACO, S. Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  MONSON, CONRAD B. Physiological aspects of EVA [SAE PAPER 860991] p 164 A87-38768  MONTE, PAUL A. Geostationary platforms - An international perspective p 121 A87-32288	[AIAA PÁPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821 Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135  MORRIS, EDGAR E. Composite fiber/metal Space Station tankage - Applications, material/process/design trades, and subscale manufacturing/test results [AIAA PAPER 87-2157] p 160 A87-45441  MORRIS, J. Space Station gas-grain simulation facility - Application to exobiology  MORSE, T. W. High speed simulation of multi-flexible-body systems with large rotations [AIAA PAPER 87-0930] p 57 A87-33730  MORTENSEN, A. J. Progress on the Ohio State University Get Away Special G-0318: DEAP	NAGATOMO, MAKOTO Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J. Wave-mode coordinates and scattering matrices for wave propagation [AD-A176998] p 29 N87-21030 Comparison of wave-mode coordinate and pulse summation methods [AD-A177795] p 30 N87-21992 Wave propagation in transversely isotropic continuum models of LSS (Large Space Structures) [AD-A177271] p 30 N87-22256  NAIDU, D. S. Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE) structure [AIAA PAPER 87-0895] p 16 A87-33689  NAKAGAWA, J. A master-slave manipulator system for space use p 147 A87-32546
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHRI, SATOSHI Autonomous decentralized system concept for Space Station p 146 A87-32541  MONACO, C. Data management system architecture options for space stations [SES/DNP/TR/002/85] p 115 N87-28585  MONACO, S. Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  MONSON, CONRAD B. Physiological aspects of EVA [SAE PAPER 860991] p 164 A87-38768  MONTE, PAUL A. Geostationary platforms - An international perspective p 121 A87-32288  MONTGOMERY, R. C. On-line identification and attitude control for SCOLE [AIAA PAPER 87-2459] p 61 A87-50505	[AIAA PÁPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [INASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821 Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135  MORRIS, EDGAR E. Composite fiber/metal Space Station tankage - Applications, material/process/design trades, and subscale manufacturing/test results [AIAA PAPER 87-2157] p 160 A87-45441  MORRIS, J. Space Station gas-grain simulation facility - Application to exobiology p 127 A87-53002  MORSE, T. W. High speed simulation of multi-flexible-body systems with large rotations [AIAA PAPER 87-0930] p 57 A87-33730  MORTESEN, A. J. Progress on the Ohio State University Get Away Special G-0318: DEAP p 170 N87-20311  MORY, R. Space Station - Overview of the European concept of	NAGATOMO, MAKOTO Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J. Wave-mode coordinates and scattering matrices for wave propagation [AD-A176998] p 29 N87-21030 Comparison of wave-mode coordinate and pulse summation methods [AD-A177795] p 30 N87-21992 Wave propagation in transversely isotropic continuum models of LSS (Large Space Structures) [AD-A177271] p 30 N87-22256  NAIDU, D. S. Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE) structure [AIAA PAPER 87-0895] p 16 A87-33689  NAKAGAWA, J. A master-slave manipulator system for space use p 147 A87-32546  NAKAJIMA, TAKASHI Concept design and cost estimation of a free-flying space platform p 146 A87-32539
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHRI, SATOSHI Autonomous decentralized system concept for Space Station p 146 A87-32541  MONACO, C. Data management system architecture options for space stations [SES/DNP/TR/002/85] p 115 N87-28585  MONACO, S. Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  MONSON, CONRAD B. Physiological aspects of EVA [SAE PAPER 860991] p 164 A87-38768  MONTGOMERY, R. C. On-line identification and attitude control for SCOLE [AIAA PAPER 87-2459] p 61 A87-50505  MONTGOMERY, RAYMOND C. An overview of controls research on the NASA Langley	[AIAA PAPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821 Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135 MORRIS, EDGAR E. Composite fiber/metal Space Station tankage - Applications, material/process/design trades, and subscale manufacturing/test results [AIAA PAPER 87-2157] p 160 A87-45441 MORRIS, J. Space Station gas-grain simulation facility - Application to exobiology MORSE, T. W. High speed simulation of multi-flexible-body systems with large rotations [AIAA PAPER 87-0930] p 57 A87-33730 MORTENSEN, A. J. Progress on the Ohio State University Get Away Special G-0318: DEAP p 170 N87-20311 MORY, R. Space Station - Overview of the European concept of Columbus programme status and content	NAGATOMO, MAKOTO Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J. Wave-mode coordinates and scattering matrices for wave propagation [AD-A176998] p 29 N87-21030 Comparison of wave-mode coordinate and pulse summation methods [AD-A177795] p 30 N87-21992 Wave propagation in transversely isotropic continuum models of LSS (Large Space Structures) [AD-A177271] p 30 N87-22256  NAIDU, D. S. Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE) structure [AIAA PAPER 87-0895] p 16 A87-33689  NAKAGAWA, J. A master-slave manipulator system for space use p 147 A87-32546  NAKAJIMA, TAKASHI Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAKAMARU, KUNIO Structural design and component tests of large
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHRI, SATOSHI Autonomous decentralized system concept for Space Station p 146 A87-32541  MONACO, C. Data management system architecture options for space stations [SES/DNP/TR/002/85] p 115 N87-28585  MONACO, S. Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  MONSON, CONRAD B. Physiological aspects of EVA [SAE PAPER 860991] p 164 A87-38768  MONTE, PAUL A. Geostationary platforms - An international perspective p 121 A87-32288  MONTGOMERY, R. C. On-line identification and attitude control for SCOLE [AIAA PAPER 87-2459] p 61 A87-50505	[AIAA PAPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821 Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135  MORRIS, EDGAR E. Composite fiber/metal Space Station tankage - Applications, material/process/design trades, and subscale manufacturing/test results [AIAA PAPER 87-2157] p 160 A87-45441  MORRIS, J. Space Station gas-grain simulation facility - Application to exobiology p 127 A87-53002  MORSE, T. W. High speed simulation of multi-flexible-body systems with large rotations [AIAA PAPER 87-0930] p 57 A87-33730  MORTENSEN, A. J. Progress on the Ohio State University Get Away Special G-3318: DEAP  MORY, R. Space Station - Overview of the European concept of Columbus programme status and content	NAGATOMO, MAKOTO Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J. Wave-mode coordinates and scattering matrices for wave propagation [AD-A176998] p 29 N87-21030 Comparison of wave-mode coordinate and pulse summation methods [AD-A177795] p 30 N87-21992 Wave propagation in transversely isotropic continuum models of LSS (Large Space Structures) [AD-A177271] p 30 N87-22256  NAIDU, D. S. Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE) structure [AIAA PAPER 87-0895] p 16 A87-33689  NAKAGAWA, J. A master-slave manipulator system for space use p 147 A87-32546  NAKAJIMA, TAKASHI Concept design and cost estimation of a free-flying space platform p 146 A87-32539
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHRI, SATOSHI Autonomous decentralized system concept for Space Station p 146 A87-32541  MONACO, C. Data management system architecture options for space stations [SES/DNP/TR/002/85] p 115 N87-28585  MONACO, S. Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  MONSON, CONRAD B. Physiological aspects of EVA [SAE PAPER 860991] p 164 A87-38768  MONTE, PAUL A. Geostationary platforms - An international perspective p 121 A87-32288  MONTGOMERY, R. C. On-line identification and attitude control for SCOLE [AIAA PAPER 87-2459]  MONTGOMERY, RAYMOND C. An overview of controls research on the NASA Langley Research Center grid MONTI, R.	[AIAA PÁPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821 Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135  MORRIS, EDGAR E. Composite fiber/metal Space Station tankage - Applications, material/process/design trades, and subscale manufacturing/test results [AIAA PAPER 87-2157] p 160 A87-45441  MORRIS, J. Space Station gas-grain simulation facility - Application to exobiology p 127 A87-53002  MORSE, T. W. High speed simulation of multi-flexible-body systems with large rotations [AIAA PAPER 87-0930] p 57 A87-33730  MORTENSEN, A. J. Progress on the Ohio State University Get Away Special G-0318: DEAP p 170 N87-20311  MORY, R. Space Station - Overview of the European concept of Columbus programme status and content  P 145 A87-32528 From Eureca-A to Eureca-B	NAGATOMO, MAKOTO  Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J.  Wave-mode coordinates and scattering matrices for wave propagation [AD-A176998] p 29 N87-21030  Comparison of wave-mode coordinate and pulse summation methods  [AD-A177795] p 30 N87-21992  Wave propagation in transversely isotropic continuum models of LSS (Large Space Structures)  [AD-A177271] p 30 N87-22256  NAIDU, D. S.  Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE) structure  [AIAA PAPER 87-0895] p 16 A87-33689  NAKAGAWA, J.  A master-slave manipulator system for space use p 147 A87-32546  NAKAJIMA, TAKASHI  Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAKAMARU, KUNIO  Structural design and component tests of large geostationary satellite bus p 144 A87-32335
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHRI, SATOSHI Autonomous decentralized system concept for Space Station p 146 A87-32541  MONACO, C. Data management system architecture options for space stations [SES/DNP/TR/002/85] p 115 N87-28585  MONACO, S. Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  MONSON, CONRAD B. Physiological aspects of EVA [SAE PAPER 860991] p 164 A87-38768  MONTE, PAUL A. Geostationary platforms - An international perspective p 121 A87-32288  MONTGOMERY, R. C. On-line identification and attitude control for SCOLE [AIAA PAPER 87-2459] p 61 A87-50505  MONTGOMERY, RAYMOND C. An overview of controls research on the NASA Langley Research Center grid p 66 N87-22720  MONTI, R. Non-intrusive techniques for thermal measurements in	[AIAA PAPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821 Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135 MORRIS, EDGAR E. Composite fiber/metal Space Station tankage - Applications, material/process/design trades, and subscale manufacturing/test results [AIAA PAPER 87-2157] p 160 A87-45441 MORRIS, J. Space Station gas-grain simulation facility - Application to exobiology MORSE, T. W. High speed simulation of multi-flexible-body systems with large rotations [AIAA PAPER 87-0930] p 57 A87-33730 MORTENSEN, A. J. Progress on the Ohio State University Get Away Special G-0318: DEAP p 170 N87-20311 MORY, R. Space Station - Overview of the European concept of Columbus programme status and content  P 145 A87-32528 MORY, ROBERT	NAGATOMO, MAKOTO Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J. Wave-mode coordinates and scattering matrices for wave propagation [AD-A176998] p 29 N87-21030 Comparison of wave-mode coordinate and pulse summation methods [AD-A177795] p 30 N87-21992 Wave propagation in transversely isotropic continuum models of LSS (Large Space Structures) [AD-A177271] p 30 N87-22256  NAIDU, D. S. Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE) structure [AIAA PAPER 87-0895] p 16 A87-33689  NAKAGAWA, J. A master-slave manipulator system for space use p 147 A87-32546  NAKAJIMA, TAKASHI Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAKAMARU, KUNIO Structural design and component tests of large geostationary satellite bus p 144 A87-32335  NAKAMURA, KENJI Observation of precipitation from space by the weather
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHRI, SATOSHI Autonomous decentralized system concept for Space Station p 146 A87-32541  MONACO, C. Data management system architecture options for space stations [SES/DNP/TR/002/85] p 115 N87-28585  MONACO, S. Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  MONSON, CONRAD B. Physiological aspects of EVA [SAE PAPER 860991] p 164 A87-38768  MONTE, PAUL A. Geostationary platforms - An international perspective p 121 A87-32288  MONTGOMERY, R. C. On-line identification and attitude control for SCOLE [AIAA PAPER 87-2459] p 61 A87-50505  MONTGOMERY, RAYMOND C. An overview of controls research on the NASA Langley Research Center grid p 66 N87-22720  MONTI, R. Non-intrusive techniques for thermal measurements in microgravity fluid science experiments	[AIAA PÁPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821 Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135  MORRIS, EDGAR E. Composite fiber/metal Space Station tankage - Applications, material/process/design trades, and subscale manufacturing/test results [AIAA PAPER 87-2157] p 160 A87-45441  MORRIS, J. Space Station gas-grain simulation facility - Application to exobiology MORSE, T. W. High speed simulation of multi-flexible-body systems with large rotations [AIAA PAPER 87-0930] p 57 A87-33730  MORTENSEN, A. J. Progress on the Ohio State University Get Away Special G-0318: DEAP MORY, R. Space Station - Overview of the European concept of Columbus programme status and content p 145 A87-32528 From Eureca-A to Eureca-B p 155 A87-53916  MORY, ROBERT Eureca - A first step towards the Space Station	NAGATOMO, MAKOTO Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J. Wave-mode coordinates and scattering matrices for wave propagation [AD-A176998] p 29 N87-21030 Comparison of wave-mode coordinate and pulse summation methods [AD-A177795] p 30 N87-21992 Wave propagation in transversely isotropic continuum models of LSS (Large Space Structures) [AD-A177271] p 30 N87-22256  NAIDU, D. S. Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE) structure [AIAA PAPER 87-0895] p 16 A87-33689  NAKAGAWA, J. A master-slave manipulator system for space use p 147 A87-32546  NAKAJIMA, TAKASHI Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAKAMARU, KUNIO Structural design and component tests of large geostationary satellite bus p 144 A87-32335  NAKAMURA, KENJI Observation of precipitation from space by the weather radar
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHRI, SATOSHI Autonomous decentralized system concept for Space Station p 146 A87-32541  MONACO, C. Data management system architecture options for space stations [SES/DNP/TR/002/85] p 115 N87-28585  MONACO, S. Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  MONSON, CONRAD B. Physiological aspects of EVA [SAE PAPER 860991] p 164 A87-38768  MONTE, PAUL A. Geostationary platforms - An international perspective p 121 A87-32288  MONTGOMERY, R. C. On-line identification and attitude control for SCOLE [AIAA PAPER 87-2459] p 61 A87-50505  MONTGOMERY, RAYMOND C. An overview of controls research on the NASA Langley Research Center grid p 66 N87-22720  MONTI, R. Non-intrusive techniques for thermal measurements in microgravity fluid science experiments	[AIAA PÁPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821 Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135  MORRIS, EDGAR E. Composite filber/metal Space Station tankage - Applications, material/process/design trades, and subscale manufacturing/test results [AIAA PAPER 87-2157] p 160 A87-45441  MORRIS, J. Space Station gas-grain simulation facility - Application to exobiology MORSE, T. W. High speed simulation of multi-flexible-body systems with large rotations [AIAA PAPER 87-0930] p 57 A87-33730  MORTENSEN, A. J. Progress on the Ohio State University Get Away Special G-0318: DEAP MORY, R. Space Station - Overview of the European concept of Columbus programme status and content  P 145 A87-32528 From Eureca-A to Eureca-B P 155 A87-53916  MORY, ROBERT Eureca - A first step towards the Space Station P 146 A87-32537	NAGATOMO, MAKOTO Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J. Wave-mode coordinates and scattering matrices for wave propagation [AD-A176998] p 29 N87-21030 Comparison of wave-mode coordinate and pulse summation methods [AD-A177795] p 30 N87-21992 Wave propagation in transversely isotropic continuum models of LSS (Large Space Structures) [AD-A177271] p 30 N87-22256  NAIDU, D. S. Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE) structure [AIAA PAPER 87-0895] p 16 A87-33689  NAKAGAWA, J. A master-slave manipulator system for space use p 147 A87-32546  NAKAJIMA, TAKASHI Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAKAMURA, KUNIO Structural design and component tests of large geostationary satellite bus p 144 A87-32335  NAKAMURA, KENJI Observation of precipitation from space by the weather radar p 145 A87-32507
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHRI, SATOSHI Autonomous decentralized system concept for Space Station p 146 A87-32541  MONACO, C. Data management system architecture options for space stations [SES/DNP/TR/002/85] p 115 N87-28585  MONACO, S. Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  MONSON, CONRAD B. Physiological aspects of EVA [SAE PAPER 860991] p 164 A87-38768  MONTE, PAUL A. Geostationary platforms - An international perspective p 121 A87-32288  MONTGOMERY, R. C. On-line identification and attitude control for SCOLE [AIAA PAPER 87-2459] p 61 A87-50505  MONTGOMERY, RAYMOND C. An overview of controls research on the NASA Langley Research Center grid p 66 N87-22720  MONTI, R. Non-intrusive techniques for thermal measurements in microgravity fluid science experiments	[AIAA PAPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821 Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135 MORRIS, EDGAR E. Composite fiber/metal Space Station tankage - Applications, material/process/design trades, and subscale manufacturing/test results [AIAA PAPER 87-2157] p 160 A87-45441 MORRIS, J. Space Station gas-grain simulation facility - Application to exobiology MORSE, T. W. High speed simulation of multi-flexible-body systems with large rotations [AIAA PAPER 87-0930] p 57 A87-33730 MORTENSEN, A. J. Progress on the Ohio State University Get Away Special g-3318: DEAP p 170 N87-20311 MORY, R. Space Station - Overview of the European concept of Columbus programme status and content  p 145 A87-32528 From Eureca-A to Eureca-B p 155 A87-53916 MORY, ROBERT Eureca - A first step towards the Space Station p 146 A87-32537	NAGATOMO, MAKOTO Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J. Wave-mode coordinates and scattering matrices for wave propagation [AD-A176998] p 29 N87-21030 Comparison of wave-mode coordinate and pulse summation methods [AD-A177795] p 30 N87-21992 Wave propagation in transversely isotropic continuum models of LSS (Large Space Structures) [AD-A177271] p 30 N87-22256  NAIDU, D. S. Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE) structure [AIAA PAPER 87-0895] p 16 A87-33689  NAKAGAWA, J. A master-slave manipulator system for space use p 147 A87-32546  NAKAJIMA, TAKASHI Concept design and cost estimation of a free-flying space platform  NAKAMARU, KUNIO Structural design and component tests of large geostationary satellite bus p 144 A87-32335  NAKAMURA, KENJI Observation of precipitation from space by the weather radar p 145 A87-32507  NAKAMURA, TATSUSABURO Thermal verification method for large sized spacecraft
[AIAA PAPER 87-2209] p 169 A87-48594  MOFFATT, MILES The development of an EVA Universal Work Station [SAE PAPER 860952] p 164 A87-38739  MOHR, GEORGE C. Robotic telepresence p 100 A87-46704  MOHRI, SATOSHI Autonomous decentralized system concept for Space Station p 146 A87-32541  MONACO, C. Data management system architecture options for space stations [SES/DNP/TR/002/85] p 115 N87-28585  MONACO, S. Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358  MONSON, CONRAD B. Physiological aspects of EVA [SAE PAPER 860991] p 164 A87-38768  MONTE, PAUL A. Geostationary platforms - An international perspective p 121 A87-32288  MONTGOMERY, R. C. On-line identification and attitude control for SCOLE [AIAA PAPER 87-2459] p 61 A87-50505  MONTGOMERY, RAYMOND C. An overview of controls research on the NASA Langley Research Center grid p 66 N87-22720  MONTI, R. Non-intrusive techniques for thermal measurements in microgravity fluid science experiments	[AIAA PÁPER 87-2120] p 93 A87-50197 A 2000-hour cyclic endurance test of a laboratory model multipropellant resistojet [NASA-TM-89854] p 96 N87-22237 Preliminary performance characterizations of an engineering model multipropellant resistojet for space station application [NASA-TM-100113] p 96 N87-23821 Water-propellant resistojets for man-tended platforms [NASA-TM-100110] p 98 N87-26135  MORRIS, EDGAR E. Composite filber/metal Space Station tankage - Applications, material/process/design trades, and subscale manufacturing/test results [AIAA PAPER 87-2157] p 160 A87-45441  MORRIS, J. Space Station gas-grain simulation facility - Application to exobiology MORSE, T. W. High speed simulation of multi-flexible-body systems with large rotations [AIAA PAPER 87-0930] p 57 A87-33730  MORTENSEN, A. J. Progress on the Ohio State University Get Away Special G-0318: DEAP MORY, R. Space Station - Overview of the European concept of Columbus programme status and content  P 145 A87-32528 From Eureca-A to Eureca-B P 155 A87-53916  MORY, ROBERT Eureca - A first step towards the Space Station P 146 A87-32537	NAGATOMO, MAKOTO Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAGEM, RAYMOND J. Wave-mode coordinates and scattering matrices for wave propagation [AD-A176998] p 29 N87-21030 Comparison of wave-mode coordinate and pulse summation methods [AD-A177795] p 30 N87-21992 Wave propagation in transversely isotropic continuum models of LSS (Large Space Structures) [AD-A177271] p 30 N87-22256  NAIDU, D. S. Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE) structure [AIAA PAPER 87-0895] p 16 A87-33689  NAKAGAWA, J. A master-slave manipulator system for space use p 147 A87-32546  NAKAJIMA, TAKASHI Concept design and cost estimation of a free-flying space platform p 146 A87-32539  NAKAMURA, KUNIO Structural design and component tests of large geostationary satellite bus p 144 A87-32335  NAKAMURA, KENJI Observation of precipitation from space by the weather radar p 145 A87-32507

Variable structure control system maneuvering of

Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams

The design and development of a two-dimensional adaptive truss structure p 40 N87-29860

spacecraft

MOTOHASHI, SHOICHI

p 64 N87-21989

p 109 N87-26200

MOOK, D. T.

MOORE, CARLETON J.

The effect of nonlinearities on flexible structures [AD-A181735] p 38 N87-

Space station structures and dynamics test program

Space station structures and dynamics test program [NASA-TP-2710] p 28 N87-20568

p 38 N87-27259

p 33 N87-22751

NAKAYAMA, K.

A master-slave manipulator system for space use

p 147 A87-32546

NAPOLITANO, L. G.

Space: New opportunities for all people; Selected Proceedings of the Thirty-seventh International Astronautical Congress, Innsbruck, Austria, Oct. 4-11, p 168 A87-41568

NAPOLITANO, LUIGI G.

Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573

NARUSE, T.

Two-time-scale design of robust controllers for large structure systems p 12 A87-32443

NASAR, S. A.

Permanent-magnet linear alternators. 1 - Fundamental equations. II - Design guidelines p 76 A87-39735

NATORI, M.

Design consideration of mechanical and deployment properties of a coilable lattice mast p 12 A87-32340

NATORI, MICHIHIRO

Model study of simplex masts p 144 A87-32339 Deployable surface truss concepts and two-dimensional adaptive structures p 144 A87-32341 Adaptive planar truss structures and their vibration characteristics

[AIAA PAPER 87-0743]

p 148 A87-33667 The design and development of a two-dimensional daptive truss structure p 40 N87-29860

Space Station propulsion system test bed and control system testing results

[AIAA PAPER 87-1858] p 91 A87-45255 NAYFEH, A. H.

The effect of nonlinearities on flexible structures [AD-A181735] p 38 N87-27259

NEEDHAM BRUCE H

Operational instruments on the Space Station-Polar Platforms - Contributions by NOAA and the international community p 127 A87-53149

ASTROS - A multidisciplinary automated structural design tool p 6 A87-33557

[AIAA PAPER 87-0713] NELEPO, YE.

Status of orbital astronomy projects

NELSON, J. M.

p 128 N87-21973 Space station integrated wall design and penetration

damage control. Task 4: Impact detection/location

[NASA-CR-179167]

p 4 N87-28583 NELSON, ROBERT W.

Advanced software tools space station focused technology p 5 N87-29164 NESMAN, T. E.

SAFE/DAE: Modal test in space

p 77 N87-20584 NESMITH, B. Nuclear reactor power for an electrically powered orbital

transfer vehicle [AIAA PAPER 87-1102] p 76 A87-41145

NETTER, G.

Demands imposed on a surface tension propellant tank

due to refuellability in the microgravity environment of outer [DGLR PAPER 86-104] p 88 A87-36756

NEVERMAN, DALE A.

Composite fiber/metal Space Station tankage Applications, material/process/design trades, and subscale manufacturing/test results

[AIAA PAPER 87-2157] p 160 A87-45441 NEVINS. J. L.

An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672]

NEWBOLD, DAVID D.

p 100 A87-41152

A membrane-based subsystem for very high recoveries of spacecraft waste waters

[SAE PAPER 8609841 p 50 A87-38763 NGUYEN, CHARLES C.

Control of robot manipulator compliance

NGUYEN, DUC T.

p 100 A87-45797

Practical implementation of an accurate method for multilevel design sensitivity analysis AIAA PAPER 87-0718] p 6 A87-33560

NGUYEN, TONY H. Q.

1987 status report - United States Air Force electric propulsion research and development [AIAA PAPER 87-1036] p 90 A87-41122

NICHOLS, THOMAS S.

Design of a mixed fleet transportation system to low Earth orbit. Volume 1: Executive summary. Volume 2: Near-term shuttle replacement. Volume 3: Heavy-lift cargo vehicle. Volume 4: Advanced technology shuttle replacement p 5 N87-29583 NIEDBAL, N.

Modal-survey testing for system identification and dynamic qualification of spacecraft structures

p 27 N87-20365 Development of experimental/analytical concepts for structural design verification [ESA-CR(P)-2340]

p 36 N87-26075 NIFL M

The Signe II gamma-ray burst experiment aboard the Prognoz 9 satellite p 150 A87-38443 p 150 A87-38443 NIEWOOD, ELI

Design of a mixed fleet transportation system to low Earth orbit. Volume 1: Executive summary. Volume 2: Near-term shuttle replacement. Volume 3: Heavy-lift cargo vehicle. Volume 4: Advanced technology replacement p 5 N87-29583 NILSEN, PETER W.

A cost effective 300 Mbps space-to-ground communications subsystem for the Space Station program p 113 A87-45521

NISHIMURA, MAKOTO

Evaluation testing of a mechanical actuator component operating in a simulated space environment

NISHIOKA, KENJI

An astrometric facility for planetary detection on the Space Station p 127 A87-50750 An astrometric facility for planetary detection on the space station

[NASA-TM-89436]

p 128 N87-20841

p 40 N87-29899

p 89 A87-38785

p 160 A87-32549

Preliminary experimental study on the oxygen separating and concentrating system for CELSS p 46 A87-32455
Gas and water recycling system for IOC vivarium experiments p 46 A87-32457 Water recycling for Space Station p 46 A87-32459

NIXON, DAVIÓ

Space station group activities habitability module study [NASA-CR-4010] p 165 N87-21585

NOGUCHI, NAOKI

Development of sensors for remote manipulator system of Japanese Experiment Module p 147 A87-32547

Advanced technology for the Space Station p 120 A87-40353

NOMURA, SHIGEAKI

Payload boomerang technology for space experiments at very low gravity level p 146 A87-32540 NOOR, AHMED K.

Computational procedures for evaluating the sensitivity derivatives of vibration frequencies and Eigenmodes of framed structures

INASA-CR-40991 NORED, DONALD L.

Manned spacecraft electrical power systems

p 75 A87-37291 NORMAN, A. M.

Space Station propulsion system test bed and control system testing results [AIAA PAPER 87-1858] p 91 A87-45255

Space station propulsion test bed: A complete system p 98 N87-26131

NORRIS, M. A.

Control of distributed structures with small nonproportional damping [AIAA PAPER 87-2250] p 60 A87-50414

NORRIS, MARK A.

Sensitivity of distributed structures to model order in feedback control

[AIAA PAPER 87-0900] p 56 A87-33710

NORTON, D. J. on Microgravity Fluid Mechanics, Symposium Proceedings of the Winter Annual Meeting, Anaheim, CA

Dec. 7-12, 1986 NOVIN, MICHAEL J.

Design of a mixed fleet transportation system to low Earth orbit. Volume 1: Executive summary. Volume 2: Near-term shuttle replacement. Volume 3: Heavy-lift cargo vehicle. Volume 4: Advanced technology shuttle replacement p 5 N87-29583

NOYES, GARY P.

An advanced carbon reactor subsystem for carbon dioxide reduction [SAE PAPER 860995] p 51 A87-38772

0

O'DONNELL, K. J.

Incorporation of the effects of material damping and nonlinearities on the dynamics of space structures p 21 A87-40075

OBAL, M. W.

Optimal vibration control by the use of piezoceramic ensors and actuators p 18 A87-33751

[AIAA PAPER 87-0959]

OBAL, MICHAEL WALTER

Vibration control of flexible structures using piezoelectric devices as sensors and actuators p 37 N87-26387 OBATA, A.

Design consideration of mechanical and deployment properties of a coilable lattice mast

OBAYASHI, T. Preliminary results of CHARGE-2 tethered payload p 121 A87-32521

OBERRIGHT, JOHN E.

Servicing of user payload equipment in the Space Station pressurized environment [SAE PAPER 860973] p 134 A87-38755

ODA, KERI L.

Degradation studies of SMRM teflon

p 106 A87-38641 OERY, H.

Recent developments and future trends in structural dynamic design verification and qualification of large

flexible spacecraft p 156 N87-20357 Development of experimental/analytical concepts for structural design verification

[ESA-CR(P)-2340] p 36 N87-26075

OFLAHERTY, PATRICK Commercialization of space -The insurance implications p 166 A87-32460

OGUCHI, MITSUO

Gas and water recycling system for IOC vivarium experiments p 46 A87-32457

OGUCHI, TETSURO

A thermally-pumped heat transport system

p 40 A87-32369

Thermal deformation and electrical degradation of antenna reflector with truss backstructure

p 12 A87-32405

OHKAMI, YOSHIAKI

Local control for large space structures D 54 A87-32440

A preliminary study on a linear inertial actuator for LSS control p 55 A87-32447

Space Station program in a long-range space development scenario of Japan D 145 A87-32530 An enclosed hangar concept for large spacecraft servicing at Space Station D 146 A87-32534

OHKAWA, KOHE

Evaluation testing of a mechanical actuator component operating in a simulated space environment p 160 A87-32549

OHNISHI. AKIRA

Thermal verification method for large sized spacecraft p 144 A87-32368

OHTA, TOSHIHIKO

Development of exposed deck of Japanese experiment p 145 A87-32532

OHTSUBO, KOHJI

Preliminary experimental study on the oxygen separating and concentrating system for CELSS p 46 A87-32455 OJIMA, YOSHIKAZU

Development of graphite epoxy space structure p 105 A87-32342

OKADA, HIROO

Automatic generation of stochastically dominant failure modes for large-scale structures p 149 A87-37853 OKAMOTO, KENICHI

Observation of precipitation from space by the weather radar p 145 A87-32507

OKAMOTO, OSAMU

A preliminary study on a linear inertial actuator for LSS control D 55 A87-32447 OKAMURA, T.

Development of the electrical power subsystem for the electric propulsion experiment onboard the Space Flyer Unit (SFU)

electric propulsion experiment onboard Space Flyer Unit

[AIAA PAPER 87-1040]

p 76 A87-39628 Development of control and monitor subsystem for

(SFU) [AIAA PAPER 87-1041]

p 76 A87-39629

OKAZAKI, K. Design consideration of mechanical and deployment properties of a coilable lattice mast p 12 A87-32340

OKAZAKI, KAKUMA Model study of simplex masts p 144 A87-32339 OKUBO. H.

Low-authority control of large space structures by using tendon control system

[AIAA PAPER 87-2249] p 60 A87-50413 OKUDA. KAZUMI

Structural design and component tests of large geostationary satellite bus p 144 A87-32335 OLDSON, JOHN C.

Electrodynamic tether propulsion - Potential uses and p 124 A87-40510

OLEN CARI	OTSUJI, K.	PARKS, D. E.
OLEN, CARL  Neutral atomic oxygen beam produced by ion charge	Concept study of regenerable carbon dioxide removal	Theory of plasma contactors for electrodynamic tethered satellite systems p 85 A87-41609
exchange for Low Earth Orbital (LEO) simulation p 131 N87-26188	and oxygen recovery system for the Space Station p 46 A87-32544	PARRISH, R. V.
OLESON, MELVIN W.	OTTO, G.	Electronic control/display interface technology p 88 N87-29161
CFLSS waste management systems evaluation	Scientific user requirements for microgravity research	PASSERON, L.
[SAE PAPER 860997] p 51 A87-387/4	(European aspects) [AIAA PAPER 87-2195] p 153 A87-48581	Dynamic modeling and optimal control design for large
OLSEN, R. C. Potential modulation on the SCATHA spacecraft	OWEN JAMES W.	flexible space structures p 26 N87-20358
p 138 A87-34460	Prototype thermal bus for manned Space Station	PATTERSON, MICHAEL Electrodynamic tether p 131 N87-26449
Potential modulations on SCATHA (Spacecraft Charging	compartments (SAE PAPER 861825) p 41 A87-32668	PATTERSON, MICHAEL J.
At High Altitude) spacecraft [AD-A176815] p 140 N87-21024	[SAE PAPER 861825] p 41 A87-32668  Maintenance components for Space Station long life	Hollow cathode-based plasma contactor experiments for
Electron beam experiments at high altitudes	fluid systems	electrodynamic tether [AIAA PAPER 87-0572] p 121 A87-32192
p 142 N87-26946	[SAE PAPER 861005] p 89 A87-38778	PAUL, S. F.
OLSEN, RICHARD C. Investigation of beam-plasma interactions	OWEN, R. G. A microgravity isolation mount p 161 N87-29861	Groundbased studies of spacecraft glow and erosion caused by impact of oxygen and nitrogen beams
[NASA-CR-180579] p 129 N87-22508	OWENS. A. R.	p 109 N87-26200
OLSEN ROY E.	A microgravity isolation mount p 161 N87-29861	PAVLINSKY, J. F.
Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769	OWENS, WILLIAM R.  An integrated analytic tool and knowledge-based system	Space Station propulsion system test bed and control
OLSON NANCIA	approach to aerospace electric power system control	system testing results [AIAA PAPER 87-1858] p 91 A87-45255
Space Station multiple access communications	[SAE PAPER 861622] p 74 A87-32579	PAWLIK, EUGENE V.
system p 86 A87-45524	OYAMA, K. I. Preliminary results of CHARGE-2 tethered payload	JPL future missions and energy storage technology mulications p 84 N87-29917
OLSON, RICHARD L.  Plant and animal accommodation for Space Station	experiment p 121 A87-32521	PAYRES. G.
Laboratory	OZGUNER, U.	Modeling, stabilization and control of serially connected
[SAE PAPER 860975] p 124 A87-38757	Control of multiple-mirror/flexible-structures in slew maneuvers	beams p 21 A87-41052 PEARCE, TONY M.
Space Station EVA using a maneuvering enclosure	[AIAA PAPER 87-2324] p 24 A87-50445	Composite fiber/metal Space Station tankage
unit [SAE PAPER 861010] p 135 A87-38782		Applications, material/process/design trades, and
OLSZEWSKI, M.	P	subscale manufacturing/test results [AIAA PAPER 87-2157] p 160 A87-45441
Application of advanced flywheel technology for energy		[AIAA PAPER 87-2157] p 160 A87-45441 PEARSON, RICHARD
storage on space station [DE87-007657] p 68 N87-24028	PABICH, PAUL J.  Developing a voice-controlled, computer-generated	Optimization of heat rejection subsystem for solar
OLSZEWSKI MITCHELL	display to assist space station astronauts during	dynamic Brayton cycle power system (SAF PAPER 860999) p 43 A87-38776
Application of advanced flywheel technology for energy	maintenance activity	[SAE PAPER 860999] p 43 A87-38776 PEDERSEN, K.
storage on space station p 74 N87-29933	[AD-A178997] p 120 N87-22762 PACK, HOMER C., JR.	Data management system architecture options for space
ONJI, AKIRA Payload boomerang technology for space experiments	Solar array flight experiment/dynamic augmentation	stations
at very low gravity level p 146 A87-32540	experiment	[SES/DNP/TR/002/85] p 115 N8/-28585 PELENC, L.
ONODA, JUNJIRO	DADIHA S I	Aerospatiale solar arrays, in orbit performance
Simultaneous structure/control optimization of large flexible spacecraft	Integrated structural electromagnetic optimization of	p 159 N87-28988
[AIAA PAPER 87-0823] p 14 A87-33610	large space antenna reflectors	PENN, JAY P.
New concepts of deployable truss units for large space	[AÍAA PAPER 87-0824] p 14 A87-33611 PAILLOUS, ALAIN	Electric propulsion for orbit transfer - A NAVSTAR case study (Has electric propulsion's time come?)
structures [AIAA PAPER 87-0868] p 14 A87-33632	Enhancement of solar absorptance degradation due to	[AIAA PAPER 87-0985] p 88 A87-38001
Alternative methods to fold/deploy tetrahedral or	contamination of solar radiator panels in geosynchronous	PENZO, PAUL A.
pentahedral truss platforms p 19 A87-34467	orbit - Correlation of flight data and laboratory measurements p 144 A87-32346	Tethers in space; Proceedings of the International Conference, Arlington, VA, Sept. 17-19, 1986
An approach to structure/control simultaneous	DALASZEWSKI B.	p 123 A87-38567
optimization for large flexible spacecraft p 22 A87-46793	Geosynchronous earth orbit base propulsion - Electric	A survey of tether applications to planetary exploration
ORANC R TARIK	propulsion options [AIAA PAPER 87-0990] p 89 A87-38004	[AAS PAPER 86-206] p 123 A87-38568
Improving stability margins in discrete-time LQG	PALETTA, F.	PEPLINSKI, DANIEL R.  Laboratory studies of atomic oxygen reactions with
controllers p 31 N87-22719	Advanced Solar GaAs Array (ASGA) experiment on EURECA: Flight objectives and instrument configuration	solids p 4 N87-26185
ORIENT, OTTO J.  Variable energy, high flux, ground-state atomic oxygen	p 83 N87-28985	PERCHONOK, MICHELE G.
source	PANICHKIN, NIKOLAI IVANOVICH	Space Station Food System [SAE PAPER 860930] p 48 A87-38720
[NASA-CASE-NPO-16640-1-CU] p 8 N87-21661	Structure and design of spacecraft p 155 A87-51870	PEREZHOGIN, A. A.
ORTON, GEORGE F.  Analytical and experimental modeling of zero/low gravity	PANOSSIAN, HAGOP V.	Stability in the relative equilibrium positions of space
fluid behavior	An assessment of recent advances in modeling and	stations at triangular libration points in the photogravitational three-body problem p 1 A87-32802
[AIAA PAPER 87-1865] p 91 A87-45260	control design of space structures under uncertainty (SAF PAPER 8618181 p 147 A87-32655	PERKINS, DOROTHY C.
Propellant tank resupply system	[SAE PAPER 861818] p 147 A87-32855 PAQUET, P.	Standards for the user interface - Developing a user
[AD-D012559] p 93 N87-20375 OSBORN, J. R.	Solid Earth panel report p 157 N87-20636	consensus
A two-dimensional numerical heat transfer model for a	PARADISO, JOSEPH A.	(,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
solar propulsion system p 74 A87-32306	A highly adaptable steering/selection procedure for combined CMG/RCS spacecraft control	PERKINS, W. A.  Complex system monitoring and fault diagnosis using
OSBORN, JIM  Near-field testing of the 5-meter model of the tetrahedral	[AAS PAPER 86-036] p 56 A87-32741	communicating expert systems p 119 A87-40363
truss antenna	PARCELIER, MICHEL PEEK (Polyether ether ketone) with 30 percent of carbon	PETERKA, D. L.  Documentation for the SHADO particle wake routine
[NASA-CR-178147] p 30 N87-21987	fibres for injection molding p 22 A87-44588	[AD-A181531] p 131 N87-26967
OSHMAN, YAAKOV Square root state estimator for large space structures	PARISH R C.	PETERSON, CHRIS
[AIAA PAPER 87-2389] p 24 A87-50473	Development of a prototype two-phase thermal bus	Design of a mixed fleet transportation system to low
OSIPYAN, YU.	system for Space Station [AIAA PAPER 87-1628] p 44 A87-43126	Earth orbit. Volume 1: Executive summary. Volume 2: Near-term shuttle replacement. Volume 3: Heavy-lift cargo
Progress in theory, technology of space materials science p 158 N87-27695	Structural and preliminary thermal performance testing	vehicle. Volume 4: Advanced technology shuttle
Science	of a pressure activated contact heat exchanger [AIAA PAPER 87-1540] p 44 A87-44843	replacement p 5 N87-29583
OSMANSKI, J. T.  Near-field testing of the 5-meter model of the tetrahedral	PARISH, RICHARD C.	PETERSON, G. P.  Determination of the cross-sectional temperature
truss antenna	Microgravity fluid management in two-phase thermal	distribution and boiling limitation of a heat pipe
[NASA-CR-178147] p 30 N87-21987	systems p 95 N87-21152	p 40 A87-32175
OSTROW, H.  Preliminary system concepts for MODIS - A moderate	PARK, K. C.  Evaluation of constraint stabilization procedures for	PETERSON, LEE D.
resolution imaging spectrometer for EOS	multibody dynamical systems	The coupled dynamics of fluids and spacecraft in low gravity and low gravity fluid measurement
p 126 A87-44186	[AIAA PAPÉR 87-0927] p 7 A87-33728	p 94 N87-21147
OTAGURO, W. S.  Fiber-optic monitors for space structures	PARKER, IAN The SERVICE concept p 134 A87-36362	PETERSON, R. V.
p 11 A87-31505	DARKER I W.	Effects on advanced materials: Results of the STS-8 EOIM (Effects of Oxygen Interaction with Materials)
OTSUBO, KOJI	Spacecraft charging in the auroral plasma: Progress toward understanding the physical effects involved	experiment
Gas and water recycling system for IOC vivarium experiments p 46 A87-32457	p 142 N87-26949	[AD-A182931] p 110 N87-29709
opposition .		

OTSUBO, KOJI
Gas and water recycling system for IOC vivarium p 46 A87-32457

PFEIFER, KARL	POHER, CLAUDE	PRIMEAUX, GARY R.
Stress and deformation analysis of lightweight composite structures	ERATO orbital transfer vehicle with electronuclear nower	Conceptual planning for Space Station life sciences
[MBB-UD-489/86] p 30 N87-22269	Study of the associated electronuclear generator	human research project
PFEIFFER, B.	POKROVSKIY, A. p 75 A87-36944	[SAE PAPER 860969] p 164 A87-38751
The Earth observation activities of the European Space Agency and the use of the polar platform of the	Pravda commentary, photos of Mir orbital station	Concepts for the evolution of the Space Station Program
International Space Station p 128 N87-20622	POLAK, ELIJAH p 158 N87-27688	[SAE PAPER 860972] p 120 A87-38754
Cooperation of the International Space Station partners	An integrated, optimization-based approach to the	PUE, A. J.
in the preparation of the use of space station elements	design and control of large space structures	Configuration tradeoffs for the space infrared telescope facility pointing control system p 121 A87-32236
for Earth observation (platform and payload aspects) p 128 N87-20631	[AD-A179459] p 34 N87-23683 POLITANSKY, H.	PULLIAM, ROBERT p 121 A87-32236
Panel report on the polar platform servicing approach	The control of linear dampers for large space	Use of heads-up displays, speech recognition, and
and its implications p 136 N87-20641 PHILIPPON, J. P.	Structures	speech synthesis in controlling a remotely piloted space
On the possibility of a several-kilovolt differential charge	[AIAA PAPER 87-2251] p 60 A87-50415 Suboptimal feedback vibration control of a beam with	A simulation capability for future space flight
in the day sector of a geosynchronous orbit	a proof-mass actuator	[SAE PAPER 861784] p 99 A87-32633
PHILLIPS, CHARLES L. p 158 N87-26953	[AIAA PAPER 87-2323] p 23 A87-50444	PURVIS, CHRISTOPHER
Improving stability margins in discrete-time LQG	PONMAN, T. J.  Coded mask telescopes for X-ray astronomy	Tether power supplies exploiting the characteristics of space
controllers p 31 N87-22719	p 123 A87-37785	[AAS PAPER 86-227] p 123 A87-38571
PHILLIPS, ELIZABETH R.  User interface design guidelines for expert	POORAN, FARHAD J.  Control of robot manipulator compliance	PUTNAM, DAVID F.
troubleshooting systems p 6 A87-33050	p 100 A87-45797	Pre- and post-treatment techniques for spacecraft water recovery
PIERSON, DUANE L.	POSPIESZCZYK, H. J.	[SAE PAPER 860982] p.50_A87-38761
Results on reuse of reclaimed shower water [SAE PAPER 860983] p 50 A87-38762	Evolution of data management systems from Spacelab to Columbus	Air Evaporation closed cycle water recovery technology
Quality requirements for reclaimed/recycled water	[AIAA PAPER 87-2227] p 154 A87-48605	- Advanced energy saving designs [SAE PAPER 860987] p 51 A87-38766
[NASA-TM-58279] p 53 N87-27392	POST, RICHARD S.	PYLE, JON S.
PILKEY, W. D.  The control of linear dampers for large space	A preliminary study of extended magnetic field structures in the ionosphere	Control of flexible structures and the research
Structures	[NASA-CR-181004] p 140 N87-23066	community p 66 N87-22732
[AIAA PAPER 87-2251] p 60 A87-50415	POWELL, F. T.	0
Suboptimal feedback vibration control of a beam with a proof-mass actuator	Environmental control and life support technologies for advanced manned space missions	Q
[AIAA PAPER 87-2323] p 23 A87-50444	[SAE PAPER 860994] p 51 A87-38771	QUEIJO, M. J.
PILMANIS, ANDREW A.	POWELL, J. R.	An advanced technology space station for the year 2025,
Hyperbaric oxygen therapy for decompression accidents - Potential applications to Space Station Operation	Nuclear propulsion systems for orbit transfer based on the particle bed reactor	study and concepts [NASA-CR-178208] p 120 N87-20340
[SAE PAPER 860927] p 163 A87-38717	[DE87-010060] p 99 N87-28405	QUINN, ALBERTA
PINNAMANENI, M.	POWELL, JIM D.	Advanced orbital servicing capabilities development
Space station structural dynamics/reaction control system interaction study p 67 N87-22753	Control/monitor instrumentation for environmental	[SAE PAPER 860992] p 134 A87-38769 QUINN, R. D.
PINSON, E. D.	control and life support systems aboard the Space Station	Equations of motion for maneuvering flexible
Preliminary design, analysis, and costing of a dynamic	[SAE PAPER 861007] p 52 A87-38779	spacecraft p 63 A87-52965
scale model of the NASA space station [NASA-CR-4068] p 36 N87-25606	POWERS, ROBERT B.	Maneuvering and vibration control of flexible spacecraft p.67 N87-22734
PINSON, LARRY D.	Optimization of payload mass placement in a dual keel space station	spacecraπ p 67 N87-22734
Future trends in spacecraft design and qualification	[NASA-TM-89051] p 68 N87-23687	R
PIPPIN, H. GARY p 2 N87-20356	PRADEEP, S.	
PIPPIN, H. GARY Structure-property relationships in polymer resistance	PRADEEP, S. Stability of time varying linear systems	RAASCH, W.
PIPPIN, H. GARY Structure-property relationships in polymer resistance to atomic oxygen  p 2 N87-20356  p 2 N87-20356  A87-38642	PRADEEP, S. Stability of time varying linear systems PRALL, JOHN S., JR.	RAASCH, W. Multi-axis vibration tests on spacecraft using hydraulic
PIPPIN, H. GARY Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-2606	PRADEEP, S. Stability of time varying linear systems  PRALL, JOHN S., JR. Thermal and dynamical effects on electrodynamic space	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters  p 8 N87-20373  RACHNIKOV, A. V.
PIPPIN, H. GARY Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206 PISTER, KARL S.	PRADEEP, S. Stability of time varying linear systems p 7 A87-37135  PRALL, JOHN S., JR. Thermal and dynamical effects on electrodynamic space tethers [AD-A180276] p 130 N87-25351	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters  P 8 N87-20373  RACHNIKOV, A. V.  Shape control of the directional pattern in a
PIPPIN, H. GARY Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206 PISTER, KARL S. An integrated, optimization-based approach to the	PRADEEP, S. Stability of time varying linear systems p 7 A87-37135  PRALL, JOHN S., JR. Thermal and dynamical effects on electrodynamic space tethers [AD-A180276] p 130 N87-25351  PRASAD, VENKATESH	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters p 8 N87-20373  RACHNIKOY, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel
PIPPIN, H. GARY Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PISTER, KARL S. An integrated, optimization-based approach to the design and control of large space structures	PRADEEP, S.  Stability of time varying linear systems  PRALL, JOHN S., JR.  Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASAD, VENKATESH  Substructure analysis using NICE/SPAR and	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters  p. 8 N87-20373  RACHNIKOV, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel  p. 148 A87-34345  The synthesis of the power transmission channel for a
PIPPIN, H. GARY Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures [AD-A179459] p 34 N87-23683  PITT, RICHARD	PRADEEP, S. Stability of time varying linear systems p 7 A87-37135  PRALL, JOHN S., JR. Thermal and dynamical effects on electrodynamic space tethers [AD-A180276] p 130 N87-25351  PRASAD, VENKATESH Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures [NASA-CR-180317] p 38 N87-27260	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters  p 8 N87-20373  RACHNIKOV, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel  p 148 A87-34345  The synthesis of the power transmission channel for a satellite solar power station  p 75 A87-35799
PIPPIN, H. GARY  Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206 PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures [AD-A179459] p 34 N87-23683 PITT, PICHARD  Status and tendencies for low to medium thrust	PRADEEP, S.  Stability of time varying linear systems  PRALL, JOHN S., JR.  Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASA, VENKATESH  Substructure analysis using applications of force to linear and nonlinear structures [NASA-CR-180317]  PRATT, MARTIN L.	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters  P 8 N87-20373  RACHNIKOV, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel  P 148 A87-34345  The synthesis of the power transmission channel for a satellite solar power station  P 75 A87-35799  RADKE-MITCHELL_LYN
PIPPIN, H. GARY Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PISTER, KARL S. An integrated, optimization-based approach to the design and control of large space structures [AD-A179459] p 34 N87-23683  PITT, RICHARD Status and tendencies for low to medium thrust propulsion systems [IAF PAPER 86-162] p 90 A87-42680	PRADEEP, S.  Stability of time varying linear systems  PRALL, JOHN S., JR.  Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASAD, VENKATESH  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures [NASA-CR-180317]  PRATT, MARTIN L.  An evolutionary approach to the development of a	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters p 8 N87-20373  RACHNIKOV, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel p 148 A87-34345  The synthesis of the power transmission channel for a satellite solar power station p 75 A87-35799  RADKE-MITCHELL, LYN  A membrane-based subsystem for very high recoveries of spacecraft waste waters
PIPPIN, H. GARY  Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures [AD-A179459] p 34 N87-23683  PITT, RICHARD p 34 N87-23683  PITT, PICHARD b 10w to medium thrust propulsion systems [IAF PAPER 86-162] p 90 A87-42680  PLAGNE, A.	PRADEEP, S.  Stability of time varying linear systems  PALL, JOHN S., JR.  Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASA, VENKATESH  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures [NASA-CR-180317]  PRATT, MARTIN L  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968]  P 49 A87-38750	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters  p 8 N87-20373  RACHNIKOV, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel  p 148 A87-34345  The synthesis of the power transmission channel for a satellite solar power station  p 75 A87-35799  RADKE-MITCHELL, LYN  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984]  p 50 A87-38763
PIPPIN, H. GARY  Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures [AD-A179459] p 34 N87-23683  PITT, RICHARD  Status and tendencies for low to medium thrust propulsion systems [IAF PAPER 86-162] p 90 A87-42680  PLAGME, A.  The high performance solar array GSR3	PRADEEP, S.  Stability of time varying linear systems  PRALL, JOHN S., JR.  Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASAD, VENKATESH  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures [NASA-CR-180317]  PRATT, MARTIN L  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968]  PREISS, H.	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters p 8 N87-20373  RACHNIKOV, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel p 148 A87-34345  The synthesis of the power transmission channel for a satellite solar power station p 75 A87-35799  RADKE-MITCHELL, LYN  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984] p 50 A87-38763  RADKE, KATHLEEN  Head-ported display analysis for Space Station
PIPPIN, H. GARY  Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures [AD-A179459] p 34 N87-23683  PITT, RICHARD  Status and tendencies for low to medium thrust propulsion systems [IAF PAPER 86-162] p 90 A87-42680  PLAGME, A.  The high performance solar array GSR3  PLANET, WALTER	PRADEEP, S.  Stability of time varying linear systems  PALL, JOHN S., JR.  Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASA, VENKATESH  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures [NASA-CR-180317]  PRATT, MARTIN L  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968]  P 49 A87-38750	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters p 8 N87-20373  RACHNIKOV, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel p 148 A87-34345  The synthesis of the power transmission channel for a satellite solar power station p 75 A87-35799  RADKE-MITCHELL, LYN  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984] p 50 A87-38763  RADKE, KATHLEEN  Head-ported display analysis for Space Station applications p 111 A87-31463
PIPPIN, H. GARY  Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures [AD-A179459] p 34 N87-23683  PITT, RICHARD Status and tendencies for low to medium thrust propulsion systems [IAF PAPER 86-162] p 90 A87-42680  PLAGME, A.  The high performance solar array GSR3  PLANET, WALTER  Planning for future operational sensors and other	PRADEEP, S.  Stability of time varying linear systems  PALL, JOHN S., JR.  Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASAD, VENKATESH  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures [NASA-CR-180317]  PATT, MARTIN L.  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968]  P 49 A87-38750  PREISS, H.  Columbus Life Support System and its technology development  [SAE PAPER 860966]  P 150 A87-38748	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters p 8 N87-20373  RACHNIKOV, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel p 148 A67-34345  The synthesis of the power transmission channel for a satellite solar power station p 75 A67-35799  RADKE-MITCHELL, LYN  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984] p 50 A87-38763  RADKE, KATHLEEN  Head-ported display analysis for Space Station applications p 111 A87-31463
PIPPIN, H. GARY  Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures [AD-A179459] p 34 N87-23683  PITT, RICHARD  Status and tendencies for low to medium thrust propulsion systems [IAF PAPER 86-162] p 90 A87-42680  PLAGNE, A.  The high performance solar array GSR3  PLANET, WALTER  Planning for future operational sensors and other priorities	PRADEEP, S. Stability of time varying linear systems  PRALL, JOHN S., JR.  Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASAD, VENKATESH  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures [NASA-CR-180317]  PRATT, MARTIN L  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968]  PREISS, H.  Columbus Life Support System and its technology development  [SAE PAPER 860966]  PREJEAN, STEPHEN E.	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters p 8 N87-20373  RACHNIKOV, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel p 148 A87-34345  The synthesis of the power transmission channel for a satellite solar power station p 75 A87-35799  RADKE-MITCHELL, LYN  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984] p 50 A87-38763  RADKE, KATHLEEN  Head-ported display analysis for Space Station applications p 111 A87-31463  RAHMET-SAMII, Y.  Antenna Technology Shuttle Experiment (ATSE)
PIPPIN, H. GARY  Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures [AD-A179459] p 34 N87-23683  PITT, RICHARD  Status and tendencies for low to medium thrust propulsion systems [IAF PAPER 86-162] p 90 A87-42680  PLAGME, A.  The high performance solar array GSR3  The high performance solar array GSR3  Planning for future operational sensors and other priorities [NOAA-NESDIS-30] p 130 N87-25560  PLEVIN, JOHN	PRADEEP, S.  Stability of time varying linear systems  PRALL, JOHN S., JR.  Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASAD, VENKATESH  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures [NASA-CR-180317]  PRATT, MARTIN L.  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968]  PREISS, H.  Columbus Life Support System and its technology development  [SAE PAPER 860966]  PREJEAN, STEPHEN E.  Space Station personal hygiene study	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters p8 N87-20373  RACHNIKOV, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel p 148 A67-34345  The synthesis of the power transmission channel for a satellite solar power station p 75 A67-35799  RADKE-MITCHELL, LYN  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984] p 50 A87-38763  RADKE, KATHLEEN  Head-ported display analysis for Space Station applications p 111 A87-31463  RAHMET-SAMII, Y.  Antenna Technology Shuttle Experiment (ATSE) p 87 N87-24508
PIPPIN, H. GARY  Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures [AD-A179459] p 34 N87-23683  PITT, RICHARD  Status and tendencies for low to medium thrust propulsion systems [IAF PAPER 86-162] p 90 A87-42680  PLAGME, A.  The high performance solar array GSR3 The high performance solar array GSR3 Planning for future operational sensors and other priorities [NOAA-NESDIS-30] p 130 N87-25560  PLEVIN, JOHN  Space Station opportunity for UK in earth sensing	PRADEEP, S. Stability of time varying linear systems  PRALL, JOHN S., JR.  Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASAD, VENKATESH  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures [NASA-CR-180317]  PRATT, MARTIN L  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968]  PREISS, H.  Columbus Life Support System and its technology development  [SAE PAPER 860966]  PREJEAN, STEPHEN E.	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters p8 N87-20373  RACHNIKOV, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel p 148 A67-34345  The synthesis of the power transmission channel for a satellite solar power station p 75 A67-35799  RADKE-MITCHELL, LYN  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984] p 50 A87-38763  RADKE, KATHLEEN  Head-ported display analysis for Space Station applications p 111 A87-31463  RAHMET-SAMII, Y.  Antenna Technology Shuttle Experiment (ATSE) p 87 N87-24508  RAJAN, S. D.  A hybrid nonlinear programming method for design
PIPPIN, H. GARY  Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures [AD-A179459] p 34 N87-23683  PITT, RICHARD  Status and tendencies for low to medium thrust propulsion systems [IAF PAPER 86-162] p 90 A87-42680  PLAGME, A.  The high performance solar array GSR3  The high performance solar array GSR3  Planning for future operational sensors and other priorities [NOAA-NESDIS-30] p 130 N87-25560  PLEVIN, JOHN	PRADEEP, S.  Stability of time varying linear systems  PRALL, JOHN S., JR.  Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASAD, VENKATESH  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures [NASA-CR-180317]  PRATT, MARTIN L  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860966]  PREISS, H.  Columbus Life Support System and its technology development  [SAE PAPER 860966]  PREJEAN, STEPHEN E.  Space Station personal hygiene study  [SAE PAPER 860931]  p 163 A87-38721	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters p8 N87-20373  RACHNIKOV, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel p 148 A67-34345  The synthesis of the power transmission channel for a satellite solar power station p 75 A67-35799  RADKE-MITCHELL, LYN  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984] p 50 A87-38763  RADKE, KATHLEEN  Head-ported display analysis for Space Station applications p 111 A87-31463  RAHMET-SAMII, Y.  Antenna Technology Shuttle Experiment (ATSE) p 87 N87-24508
PIPPIN, H. GARY  Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures [AD-A179459] p 34 N87-23683  PITT, RICHARD  Status and tendencies for low to medium thrust propulsion systems [IAF PAPER 86-162] p 90 A87-42680  PLAGNE, A.  The high performance solar array GSR3 p 81 N87-28972  PLANET, WALTER Planning for future operational sensors and other priorities [NOAA-NESDIS-30] p 130 N87-25560  PLEVIN, JOHN Space Station opportunity for UK in earth sensing p 152 A87-41678  PLUMAT, Y. Dynamic analysis of direct television satellite	PRADEEP, S.  Stability of time varying linear systems  PALL, JOHN S., JR.  Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASAD, VENKATESH  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures [NASA-CR-180317]  PRATT, MARTIN L  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860988]  PREISS, H.  Columbus Life Support System and its technology development  [SAE PAPER 860966]  PREJSAN, STEPHEN E.  Space Station personal hygiene study  [SAE PAPER 860931]  PREMACK, TIMOTHY  Control of robot manipulator compliance	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters p8 N87-20373  RACHNIKOV, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel p 148 A87-34345  The synthesis of the power transmission channel for a satellite solar power station p 75 A87-35799  RADKE-MITCHELL, LYN  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984] p 50 A87-38763  RADKE, KATHLEEN  Head-ported display analysis for Space Station applications p 111 A87-31463  RAHMET-SAMII, Y.  Antenna Technology Shuttle Experiment (ATSE) p 87 N87-24508  RAJAN, S. D.  A hybrid nonlinear programming method for design optimization p 7 A87-35718  RAMBAUT, PAUL C.  Foods and nutrition in space
PIPPIN, H. GARY  Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206 PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures [AD-A179459] p 34 N87-23683 PITT, RICHARD p 34 N87-23683 PITT, RICHARD p 90 A87-42680 PLAGNE, A. The high performance solar array GSR3 p 81 N87-28972 PLANET, WALTER Planning for future operational sensors and other priorities [NOA-NESDIS-30] p 130 N87-25560 PLEVIN, JOHN Space Station opportunity for UK in earth sensing p 152 A87-41678 PLUMAT, Y. Dynamic analysis of direct television satellite TV-SAT/TDF:1 p 86 N87-29390	PRADEEP, S.  Stability of time varying linear systems  PALL, JOHN S., JR.  Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASAD, VENKATESH  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures [NASA-CR-180317]  PRATT, MARTIN L  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968]  PREISS, H.  Columbus Life Support System and its technology development  [SAE PAPER 860966]  PREJEAN, STEPHEN E.  Space Station personal hygiene study  [SAE PAPER 860931]  PREMACK, TIMOTHY  Control of robot manipulator compliance  p 100 A87-45797  PRENGER, F. C.	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters p 8 N87-20373  RACHNIKOV, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel p 148 A87-34345  The synthesis of the power transmission channel for a satellite solar power station p 75 A87-35799  RADKE-MITCHELL, LYN  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984] p 50 A87-38763  RADKE, KATHLEEN  Head-ported display analysis for Space Station applications p 111 A87-31463  RAHMET-SAMII, Y.  Antenna Technology Shuttle Experiment (ATSE) p 87 N87-24508  RAJAN, S. D.  A hybrid nonlinear programming method for design optimization p 7 A87-35718  RAMBAUT, PAUL C.  Foods and nutrition in space [SAE PAPER 860926] p 47 A87-38716
PIPPIN, H. GARY  Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures [AD-A179459] p 34 N87-23683  PITT, RICHARD  Status and tendencies for low to medium thrust propulsion systems [IAF PAPER 86-162] p 90 A87-42680  PLAGME, A.  The high performance solar array GSR3  PLAMET, WALTER  Planning for future operational sensors and other priorities [NOAA-NESDIS-30] p 130 N87-25560  PLEVIN, JOHN  Space Station opportunity for UK in earth sensing p 152 A87-41678  PLUMAT, Y.  Dynamic analysis of direct television satellite TV-SAT/TDF-1  PLUMMER, S. E.	PRADEEP, S.  Stability of time varying linear systems  PRALL, JOHN S., JR.  Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASAD, VENKATESH  Substructure analysis using applications of force to linear and nonlinear structures [NASA-CR-180317]  PRATT, MARTIN L  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968]  PREISS, H.  Columbus Life Support System and its technology development  [SAE PAPER 860966]  PREJEAN, STEPHEN E.  Space Station personal hygiene study  [SAE PAPER 860931]  PREMACK, TIMOTHY  Control of robot manipulator compliance  p 100  A87-45797  PRENGER, F. C.  Magnetic refrigeration for space platforms  [SAE PAPER 861724]  p 118  A87-32613	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters p 8 N87-20373  RACHNIKOV, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel p 148 A87-34345  The synthesis of the power transmission channel for a satellite solar power station p 75 A87-35799  RADKE-MITCHELL, LYN  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984] p 50 A87-38763  RADKE, KATHLEEN  Head-ported display analysis for Space Station applications p 111 A87-31463  RAHMET-SAMII, Y.  Antenna Technology Shuttle Experiment (ATSE) p 87 N87-24508  RAJAN, S. D.  A hybrid nonlinear programming method for design optimization p 7 A87-35718  RAMBAUT, PAUL C.  Foods and nutrition in space [SAE PAPER 860926]  RANEY, WILLIAM P.  The Space Station overview p 168 A87-41571
PIPPIN, H. GARY  Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206 PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures [AD-A179459] p 34 N87-23683 PITT, RICHARD p 34 N87-23683 PITT, PICHARD p 90 A87-42680 PLAGNE, A.  The high performance solar array GSR3 p 81 N87-28972 PLAMET, WALTER Planning for future operational sensors and other priorities [NOAA-NESDIS-30] p 130 N87-25560 PLEVIN, JOHN Space Station opportunity for UK in earth sensing p 152 A87-41678 PLUMAT, Y. Dynamic analysis of direct television satellite TV-SAT/TDF.1 p 86 N87-20360 PLUMMER, S. E. A polar platform for the remote sensing needs of ecology and agriculture - A view from the U.K.	PRADEEP, S.  Stability of time varying linear systems  PRALL, JOHN S., JR.  Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASAD, VENKATESH  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures [NASA-CR-180317]  PRATT, MARTIN L  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968]  PREISS, H.  Columbus Life Support System and its technology development  [SAE PAPER 860966]  PREJEAN, STEPHEN E.  Space Station personal hygiene study  [SAE PAPER 860931]  PREMACK, TIMOTHY  Control of robot manipulator compliance  p 100  A87-45797  PRENGER, F. C.  Magnetic refrigeration for space platforms  [SAE PAPER 861724]  PREUMONT, ANDRE	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters p 8 N87-20373  RACHNIKOV, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel p 148 A87-34345  The synthesis of the power transmission channel for a satellite solar power station p 75 A87-35799  RADKE-MITCHELL, LYN  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984] p 50 A87-38763  RADKE, KATHLEEN  Head-ported display analysis for Space Station applications p 111 A87-31463  RAHMET-SAMII, Y.  Antenna Technology Shuttle Experiment (ATSE) p 87 N87-24508  RAJAN, S. D.  A hybrid nonlinear programming method for design optimization p 7 A87-35718  RAMBAUT, PAUL C.  Foods and nutrition in space  [SAE PAPER 860926] p 47 A87-38716  RANEY, WILLIAM P.  The Space Station overview p 168 A87-41571
PIPPIN, H. GARY  Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures [AD-A179459] p 34 N87-23683  PITT, RICHARD  Status and tendencies for low to medium thrust propulsion systems [IAF PAPER 86-162] p 90 A87-42680  PLAGME, A.  The high performance solar array GSR3  PLAMET, WALTER  Planning for future operational sensors and other priorities [NOAA-NESDIS-30] p 130 N87-25560  PLEVIN, JOHN  Space Station opportunity for UK in earth sensing p 152 A87-41678  PLUMAT, Y.  Dynamic analysis of direct television satellite TV-SAT/TDF-1 p 86 N87-20360  PLUMMER, S. E.  A polar platform for the remote sensing needs of ecology and agriculture - A view from the U.K.	PRADEEP, S.  Stability of time varying linear systems  PRALL, JOHN S., JR.  Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASAD, VENKATESH  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures [NASA-CR-180317]  PRATT, MARTIN L.  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968]  PREISS, H.  Columbus Life Support System and its technology development  [SAE PAPER 860966]  PREJEAN, STEPHEN E.  Space Station personal hygiene study  [SAE PAPER 860931]  PREMACK, TIMOTHY  Control of robot manipulator compliance  p 100  A87-45797  PRENGER, F. C.  Magnetic refrigeration for space platforms  [SAE PAPER 861724]  PREUMONT, ANDRE  Spillover stabilization and decentralized modal control	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters p8 N87-20373  RACHNIKOV, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel p148 A67-34345  The synthesis of the power transmission channel for a satellite solar power station p75 A87-35799  RADKE-MITCHELL, LYN  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984] p50 A87-38763  RADKE, KATHLEEN  Head-ported display analysis for Space Station applications p111 A87-31463  RAHMET-SAMII, Y.  Antenna Technology Shuttle Experiment (ATSE) p87 N87-24508  RAJAN, S. D.  A hybrid nonlinear programming method for design optimization p7 A87-35718  RAMBAUT, PAUL C. Foods and nutrition in space [SAE PAPER 860926] p47 A87-38716  RANEY, WILLIAM P. The Space Station overview p168 A87-41571  RANKIN, J. GARY Thermal test results of the two-phase thermal bus
PIPPIN, H. GARY  Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206 PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures [AD-A179459] p 34 N87-23683 PITT, RICHARD  Status and tendencies for low to medium thrust propulsion systems [IAF PAPER 86-162] p 90 A87-42680 PLAGNE, A.  The high performance solar array GSR3 p 81 N87-28972 PLANET, WALTER Planning for future operational sensors and other priorities [NOAA-NESDIS-30] p 130 N87-25560 PLEVIN, JOHN Space Station opportunity for UK in earth sensing p 152 A87-41678 PLUMAT, Y. Dynamic analysis of direct television satellite TV-SAT/TDF-1 PLUMMER, S. E. A polar platform for the remote sensing needs of ecology and agriculture - A view from the U.K. POELSTRA, J.	PRADEEP, S. Stability of time varying linear systems  PRALL, JOHN S., JR. Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASAD, VENKATESH Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures [NASA-CR-180317]  PRATT, MARTIN L. An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968]  PREISS, H. Columbus Life Support System and its technology development  [SAE PAPER 860966]  PREJEAN, STEPHEN E. Space Station personal hygiene study  [SAE PAPER 860931]  PREMACK, TIMOTHY Control of robot manipulator compliance  p 100  PRENGER, F. C. Magnetic refrigeration for space platforms  [SAE PAPER 861724]  PREUMONT, ANDRE  Spillover stabilization and decentralized modal control of large space structures	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters p8 N87-20373  RACHNIKOV, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel p 148 A87-34345  The synthesis of the power transmission channel for a satellite solar power station p 75 A87-35799  RADKE-MITCHELL, LYN  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984] p 50 A87-38763  RADKE, KATHLEEN  Head-ported display analysis for Space Station applications p 111 A87-31463  RAHMET-SAMII, Y.  Antenna Technology Shuttle Experiment (ATSE) p 87 N87-24508  RAJAN, S. D.  A hybrid nonlinear programming method for design optimization p 7 A87-35718  RAMBAUT, PAUL C.  Foods and nutrition in space [SAE PAPER 860926] p 47 A87-38716  RANEY, WILLIAM P.  The Space Station overview p 168 A87-41571  RANKIN, J. GARY  Thermal test results of the two-phase thermal bus technology demonstration loop
PIPPIN, H. GARY  Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures  [AD-A179459] p 34 N87-23683  PITT, RICHARD p 34 N87-23683  PITT, RICHARD p 90 A87-42680  PLAGME, A.  The high performance solar array GSR3 p 81 N87-28972  PLANET, WALTER Planning for future operational sensors and other priorities  [NOAA-NESDIS-30] p 130 N87-25560  PLEVIN, JOHN Space Station opportunity for UK in earth sensing p 152 A87-41678  PLUMAT, Y.  Dynamic analysis of direct television satellite TV-SAT/TOF-1 p 86 N87-20360  PLUMMER, S. E.  A polar platform for the remote sensing needs of ecology and agriculture - A view from the U.K.  POELSTRA, J.  A study of fluid transfer management in space  [FTMS-RPT-006] p 7 N87-26058	PRADEEP, S.  Stability of time varying linear systems  PALL, JOHN S., JR.  Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASAD, VENKATESH  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures [NASA-CR-180317]  PRATT, MARTIN L.  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968]  PREISS, H.  Columbus Life Support System and its technology development  [SAE PAPER 860966]  PREJEAN, STEPHEN E.  Space Station personal hygiene study  [SAE PAPER 860931]  PREMACK, TIMOTHY  Control of robot manipulator compliance  p 100  PRENGER, F. C.  Magnetic refrigeration for space platforms  [SAE PAPER 861724]  PREUMONT, ANDRE  Spillover stabilization and decentralized modal control of large space structures  [AIAA PAPER 87-0903]  PRICE, C. R.	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters p8 N87-20373  RACHNIKOV, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel p 148 A67-34345  The synthesis of the power transmission channel for a satellite solar power station p 75 A67-35799  RADKE-MITCHELL, LYN  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984] p 50 A87-38763  RADKE, KATHLEEN  Head-ported display analysis for Space Station applications p 111 A87-31463  RAHMET-SAMII, Y.  Antenna Technology Shuttle Experiment (ATSE) p 87 N87-24508  RAJAN, S. D.  A hybrid nonlinear programming method for design optimization p 7 A87-35718  RAMBAUT, PAUL C. Foods and nutrition in space [SAE PAPER 860926] p 47 A87-38716  RANEY, WILLIAM P.  The Space Station overview p 168 A87-41571  RANKIN, J. GARY  Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125
PIPPIN, H. GARY  Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206 PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures [AD-A179459] p 34 N87-23683 PITT, RICHARD  Status and tendencies for low to medium thrust propulsion systems [IAF PAPER 86-162] p 90 A87-42680 PLAGNE, A.  The high performance solar array GSR3 p 81 N87-28972 PLANET, WALTER Planning for future operational sensors and other priorities [NOAA-NESDIS-30] p 130 N87-25560 PLEVIN, JOHN Space Station opportunity for UK in earth sensing p 152 A87-41678 PLUMAT, Y. Dynamic analysis of direct television satellite TV-SAT/TDF-1 p 86 N87-20360 PLUMMER, S. E. A polar platform for the remote sensing needs of ecology and agriculture - A view from the U.K.  POELSTRA, J. A study of fluid transfer management in space [FTMS-RPT-006] p 97 N87-26058	PRADEEP, S.  Stability of time varying linear systems  PRALL, JOHN S., JR.  Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASAD, VENKATESH  Substructure analysis using applications of force to linear and nonlinear structures [NAS-CR-180317]  PRATT, MARTIN L  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968]  PREISS, H.  Columbus Life Support System and its technology development  [SAE PAPER 860966]  PREJEAN, STEPHEN E.  Space Station personal hygiene study  [SAE PAPER 860931]  PREMACK, TIMOTHY  Control of robot manipulator compliance  p 100 A87-45797  PRENGER, F. C.  Magnetic refrigeration for space platforms  [SAE PAPER 861724]  PREUMONT, ANDRE  Spillover stabilization and decentralized modal control of large space structures  [AIAA PAPER 87-0903]  PRICE, C. R.  Track and capture of the orbiter with the space station	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters p8 N87-20373  RACHNIKOV, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel p148 A87-34345  The synthesis of the power transmission channel for a satellite solar power station p75 A87-35799  RADKE-MITCHELL, LYN  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984] p50 A87-38763  RADKE, KATHLEEN  Head-ported display analysis for Space Station applications p111 A87-31463  RAHMET-SAMII, Y.  Antenna Technology Shuttle Experiment (ATSE)  P87 N87-24508  RAJAN, S. D.  A hybrid nonlinear programming method for design optimization p7 A87-35718  RAMBAUT, PAUL C.  Foods and nutrition in space  [SAE PAPER 860926] p47 A87-38716  RANEY, WILLIAM P.  The Space Station overview p168 A87-41571  RANKIN, J. GARY  Thermal test results of the two-phase thermal bus technology demonstration loop  [AIAA PAPER 87-1627] p44 A87-43125  RANTANEN, R.  Contamination assessment for OSSA space station IOC
PIPPIN, H. GARY  Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206  PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures  [AD-A179459] p 34 N87-23683  PITT, RICHARD p 34 N87-23683  PITT, RICHARD p 90 A87-42680  PLAGME, A.  The high performance solar array GSR3 p 81 N87-28972  PLANET, WALTER Planning for future operational sensors and other priorities  [NOAA-NESDIS-30] p 130 N87-25560  PLEVIN, JOHN Space Station opportunity for UK in earth sensing p 152 A87-41678  PLUMAT, Y.  Dynamic analysis of direct television satellite TV-SAT/TOF-1 p 86 N87-20360  PLUMMER, S. E.  A polar platform for the remote sensing needs of ecology and agriculture - A view from the U.K.  POELSTRA, J.  A study of fluid transfer management in space  [FTMS-RPT-006] p 7 N87-26058	PRADEEP, S.  Stability of time varying linear systems  p 7 A87-37135  PRALL, JOHN S., JR.  Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASAD, VENKATESH  Substructure analysis using applications of force to linear and nonlinear structures [NASA-CR-180317]  PRATTI, MARTIN L.  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968]  PREISS, H.  Columbus Life Support System and its technology development  [SAE PAPER 860966]  PREJEAN, STEPHEN E.  Space Station personal hygiene study  [SAE PAPER 860931]  PREMACK, TIMOTHY  Control of robot manipulator compliance  p 100 A87-45797  PRENGER, F. C.  Magnetic refrigeration for space platforms  [SAE PAPER 861724]  PREUMONT, ANDRE  Spillover stabilization and decentralized modal control of large space structures  [AIAA PAPER 87-0903]  PRICE, C. R.  Track and capture of the orbiter with the space station remote manipulator system	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters p8 N87-20373  RACHNIKOV, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel p148 A87-34345  The synthesis of the power transmission channel for a satellite solar power station p75 A87-35799  RADKE-MITCHELL, LYN  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984] p50 A87-38763  RADKE, KATHLEEN  Head-ported display analysis for Space Station applications p111 A87-31463  RAHMET-SAMII, Y.  Antenna Technology Shuttle Experiment (ATSE) p87 N87-24508  RAJAN, S. D.  A hybrid nonlinear programming method for design optimization p7 A87-35718  RAMBAUT, PAUL C. Foods and nutrition in space [SAE PAPER 860926] p47 A87-38716  RANEY, WILLIAM P.  The Space Station overview p168 A87-41571  RANKIN, J. GARY  Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p44 A87-43125  RANTANEN, R.  Contamination assessment for OSSA space station IOC payloads [NASA-CR-4091] p53 N87-26086
PIPPIN, H. GARY  Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206 PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures [AD-A179459] p 34 N87-23683 PITT, RICHARD  Status and tendencies for low to medium thrust propulsion systems [IAF PAPER 86-162] p 90 A87-42680 PLAGNE, A.  The high performance solar array GSR3 p 81 N87-28972 PLANET, WALTER Planning for future operational sensors and other priorities [NOAA-NESDIS-30] p 130 N87-25560 PLEVIN, JOHN Space Station opportunity for UK in earth sensing p 152 A87-41678 PLUMAT, Y.  Dynamic analysis of direct television satellite TV-SAT/TDF-1 p 86 N87-20360 PLUMMER, S. E.  A polar platform for the remote sensing needs of ecology and agriculture - A view from the U.K.  POELSTRA, J.  A study of fluid transfer management in space [FTMS-RPT-006] p 97 N87-26058 POH, S.  Modified independent modal space control method for active control of flexible systems [NASA-CR-181065] p 34 N87-23980	PRADEEP, S.  Stability of time varying linear systems  p 7 A87-37135  PRALL, JOHN S., JR. Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASAD, VENKATESH  Substructure analysis using applications of force to linear and nonlinear structures [NASA-CR-180317]  PRATT, MARTIN L  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968]  PREISS, H.  Columbus Life Support System and its technology development  [SAE PAPER 860966]  PREJEAN, STEPHEN E.  Space Station personal hygiene study  [SAE PAPER 860931]  PREMACK, TIMOTHY  Control of robot manipulator compliance  p 100 A87-36721  PRENGER, F. C.  Magnetic refrigeration for space platforms  [SAE PAPER 861724]  PREUMONT, ANDRE  Spillover stabilization and decentralized modal control of large space structures  [AIAA PAPER 87-0903]  PRICE, C. R.  Track and capture of the orbiter with the space station remote manipulator system  [NASA-TM-89221]  PRICE, DONALD F.	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters p8 N87-20373  RACHNIKOV, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel p148 A67-34345  The synthesis of the power transmission channel for a satellite solar power station p75 A87-35799  RADKE-MITCHELL, LYN  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984] p50 A87-38763  RADKE, KATHLEEN  Head-ported display analysis for Space Station applications p111 A87-31463  RAHMET-SAMII, Y.  Antenna Technology Shuttle Experiment (ATSE) p87 N87-24508  RAJAN, S. D.  A hybrid nonlinear programming method for design optimization p7 A87-35718  RAMBAUT, PAUL C. Foods and nutrition in space [SAE PAPER 860926] p47 A87-38716  RANEY, WILLIAM P.  The Space Station overview p168 A87-41571  RANKIN, J. GARY  Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p44 A87-43125  RANTANN, R.  Contamination assessment for OSSA space station IOC payloads (NASA-CR-4091] p53 N87-26086
PIPPIN, H. GARY  Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206 PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures [AD-A179459] p 34 N87-23683 PITT, RICHARD p 36 N87-24680 PLAGNE, A.  The high performance solar array GSR3 p 81 N87-28972 PLAGNE, A.  The high performance solar array GSR3 p 81 N87-28972 PLAMET, WALTER Planning for future operational sensors and other priorities [NOAA-NESDIS-30] p 130 N87-25560 PLEVIN, JOHN Space Station opportunity for UK in earth sensing p 152 A87-41678 PLUMAT, Y.  Dynamic analysis of direct television satellite TV-SAT/TDF-1 p 86 N87-20360 PLUMMER, S. E.  A polar platform for the remote sensing needs of ecology and agriculture - A view from the U.K.  POELSTRA, J.  A study of fluid transfer management in space [FTMS-RPT-006] p 97 N87-26058 POH, S.  Modified independent modal space control method for active control of flexible systems [NASA-CR-181065] p 34 N87-23980 A comparison between IMSC. Pl and MIMSC methods	Stability of time varying linear systems  PRALL, JOHN S., JR.  Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASAD, VENKATESH  Substructure analysis using applications of force to linear and nonlinear structures [NASA-CR-180317]  PRATTI, MARTIN L  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968]  PREISS, H.  Columbus Life Support System and its technology development  [SAE PAPER 860966]  PREJEAN, STEPHEN E.  Space Station personal hygiene study  [SAE PAPER 860931]  PREMACK, TIMOTHY  Control of robot manipulator compliance  p 100  A87-45797  PRENGER, F. C.  Magnetic refrigeration for space platforms  [SAE PAPER 861724]  PREUMONT, ANDRE  Spillover stabilization and decentralized modal control of large space structures  [AIAA PAPER 87-0903]  PRICE, C. R.  Track and capture of the orbiter with the space station remote manipulator system  [NASA-TM-89221]  PRICE, DONALD F.  A membrane-based subsystem for very high recoveries	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters p8 N87-20373  RACHNIKOV, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel p148 A87-34345  The synthesis of the power transmission channel for a satellite solar power station p75 A87-35799  RADKE-MITCHELL, LYN  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984] p50 A87-38763  RADKE, KATHLEN  Head-ported display analysis for Space Station applications p111 A87-31463  RAHMET-SAMII, Y.  Antenna Technology Shuttle Experiment (ATSE) p87 N87-24508  RAJAN, S. D.  A hybrid nonlinear programming method for design optimization p7 A87-35718  RAMBAUT, PAUL C. Foods and nutrition in space [SAE PAPER 860926] p47 A87-38716  RANEY, WILLIAM P.  The Space Station overview p168 A87-41571  RANKIN, J. GARY  Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p44 A87-43125  RANTANEN, R.  Contamination assessment for OSSA space station IOC payloads [NASA-CR-4091] p53 N87-26086
PIPPIN, H. GARY  Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206 PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures [AD-A179459] p 34 N87-23683 PITT, RICHARD  Status and tendencies for low to medium thrust propulsion systems [IAF PAPER 86-162] p 90 A87-42680 PLAGNE, A.  The high performance solar array GSR3 p 81 N87-28972 PLANET, WALTER Planning for future operational sensors and other priorities [NOAA-NESDIS-30] p 130 N87-25560 PLEVIN, JOHN Space Station opportunity for UK in earth sensing p 152 A87-41678 PLUMAT, Y.  Dynamic analysis of direct television satellite TV-SAT/TDF-1 p 86 N87-20360 PLUMBER, S. E.  A polar platform for the remote sensing needs of ecology and agriculture - A view from the U.K.  POELSTRA, J.  A study of fluid transfer management in space [FTMS-RPT-006] p 97 N87-26058 POH, S.  Modified independent modal space control method for active control of flexible systems [NASA-CR-181065] p 34 N87-23880 A comparison between IMSC, PI and MIMSC methods in controlling the vibration of flexible systems [NASA-CR-181156] p 36 N87-25605	Stability of time varying linear systems  PRALL, JOHN S., JR.  Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASAD, VENKATESH  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures [NASA-CR-180317]  PRATT, MARTIN L  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968]  PREISS, H.  Columbus Life Support System and its technology development  [SAE PAPER 860966]  PREJSAN, STEPHEN E.  Space Station personal hygiene study  [SAE PAPER 860931]  PREMACK, TIMOTHY  Control of robot manipulator compliance  p 100  A87-45797  PREUMONT, ANDRE  Spillover stabilization and decentralized modal control of large space structures  [AIAA PAPER 87-0903]  PRICE, C. R.  Track and capture of the orbiter with the space station remote manipulator system  [NASA-TM-89221]  PRICE, DONALD F.  A membrane-based subsystem for very high recoveries of spacecraft waste waters	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters p8 N87-20373  RACHNIKOV, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel p148 A87-34345  The synthesis of the power transmission channel for a satellite solar power station p75 A87-35799  RADKE-MITCHELL, LYN  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984] p50 A87-38763  RADKE, KATHLEEN  Head-ported display analysis for Space Station applications p111 A87-31463  RAHMET-SAMII, Y.  Antenna Technology Shuttle Experiment (ATSE) p87 N87-24508  RAJAN, S. D.  A hybrid nonlinear programming method for design optimization p7 A87-35718  RAMBAUT, PAUL C.  Foods and nutrition in space [SAE PAPER 860926] p47 A87-38716  RANEY, WILLIAM P.  The Space Station overview p168 A87-41571  RANKIN, J. GARY  Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p44 A87-43125  RANTANEN, R.  Contamination assessment for OSSA space station IOC payloads [NASA-CR-4091] p53 N87-26086  RASMUSSEN, DARYL N.  Life Sciences Research Facility automation requirements and concepts for the Space Station [SAE PAPER 860970] p50 A87-38752
PIPPIN, H. GARY  Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206 PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures [AD-A179459] p 34 N87-23683 PITT, PICHARD p 90 A87-42680 PLAGNE, A.  The high performance solar array GSR3 p 81 N87-28972 PLAMET, WALTER Planning for future operational sensors and other priorities [NOAA-NESDIS-30] p 130 N87-25560 PLEVIN, JOHN Space Station opportunity for UK in earth sensing p 152 A87-41678 PLUMAT, Y.  Dynamic analysis of direct television satellite TV-SAT/TDF.1 p 86 N87-20360 PLUMAT, S. E.  A polar platform for the remote sensing needs of ecology and agriculture - A view from the U.K.  POELSTRA, J.  A study of fluid transfer management in space [FTMS-RPT-006] p 97 N87-26058 POH, S.  Modified independent modal space control method for active control of flexible systems [NASA-CR-181065] p 34 N87-23980 A comparison between IMSC, PI and MIMSC methods in controlling the vibration of the performance of a	PRADEEP, S.  Stability of time varying linear systems  PRALL, JOHN S., JR.  Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASAD, VENKATESH  Substructure analysis using applications of force to linear and nonlinear structures [NASA-CR-180317]  PRATT, MARTIN L.  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860988]  PREISS, H.  Columbus Life Support System and its technology development  [SAE PAPER 860966]  PREJEAN, STEPHEN E.  Space Station personal hygiene study  [SAE PAPER 860931]  PREMACK, TIMOTHY  Control of robot manipulator compliance  p 100  PREMER, F. C.  Magnetic refrigeration for space platforms  [SAE PAPER 861724]  PREUMONT, ANDRE  Spillover stabilization and decentralized modal control of large space structures  [AIAA PAPER 87-0903]  PRICE, C. R.  Track and capture of the orbiter with the space station remote manipulator system  [NASA-TM-89221]  PRICE, DONALD F.  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984]  PRICE, MAROLD G.	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters p8 N87-20373  RACHNIKOY, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel p148 A87-34345  The synthesis of the power transmission channel for a satellite solar power station p75 A87-35799  RADKE-MITCHELL, LYN  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984] p50 A87-38763  RADKE, KATHLEEN p50 A87-38763  RADKE, KATHLEEN p11 A87-31463  RAHMET-SAMII, Y.  Arienna Technology Shuttle Experiment (ATSE) p87 N87-24508  RAJAN, S. D.  A hybrid nonlinear programming method for design optimization p7 A87-35718  RAMBAUT, PAUL C.  Foods and nutrition in space  [SAE PAPER 860926] p47 A87-38716  RANKIN, J. GARY  Thermal test results of the two-phase thermal bus technology demonstration loop  [AIAA PAPER 87-1627] p44 A87-43125  RANTANEN, R.  Contamination assessment for OSSA space station IOC payloads  [NASA-CR-4091] p53 N87-26086  RASMUSSEN, DARYL N.  Life Sciences Research Facility automation requirements and concepts for the Space Station  [SAE PAPER 860970] p50 A87-38752
PIPPIN, H. GARY  Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206 PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures [AD-A179459] p 34 N87-23683 PITT, RICHARD p 34 N87-23683 PITT, RICHARD p 34 N87-23683 PITT, PICHARD p 34 N87-23683 PITT, PICHARD p 34 N87-23683 PITT, PICHARD p 36 N87-24680 PLAGNE, A.  The high performance solar array GSR3 p 81 N87-28972 PLAMET, WALTER Planning for future operational sensors and other priorities [NOAA-NESDIS-30] p 130 N87-25560 PLEVIN, JOHN Space Station opportunity for UK in earth sensing PLUMAT, Y. Dynamic analysis of direct television satellite TV-SAT/TDF-1 p 86 N87-20360 PLUMER, S. E. A polar platform for the remote sensing needs of ecology and agriculture - A view from the U.K.  POELSTRA, J. A study of fluid transfer management in space [FTMS-RPT-006] p 97 N87-26058 POH, S. Modified independent modal space control method for active control of flexible systems [NASA-CR-181065] p 34 N87-23980 A comparison between IMSC, PI and MIMSC methods in controlling the vibration of flexible systems [NASA-CR-181156] p 36 N87-25605 Effect of bonding on the performance of a piezoactuator-based active control system	Stability of time varying linear systems  PRALL, JOHN S., JR.  Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASAD, VENKATESH  Substructure analysis using applications of force to linear and nonlinear structures [NASA-CR-180317]  PRATT, MARTIN L  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860968]  PREISS, H.  Columbus Life Support System and its technology development  [SAE PAPER 860966]  PREJEAN, STEPHEN E.  Space Station personal hygiene study  [SAE PAPER 860931]  PREMACK, TIMOTHY  Control of robot manipulator compliance  p 100  A87-45797  PRENGER, F. C.  Magnetic refrigeration for space platforms  [SAE PAPER 861724]  PREUMONT, ANDRE  Spillover stabilization and decentralized modal control of large space structures  [AIAA PAPER 87-0903]  PRICE, C. R.  Track and capture of the orbiter with the space station remote manipulator system  [NASA-TM-89221]  PRICE, DONALD F.  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984]  PSICE, HAROLD G.  Proven, long-life hydrogen/oxygen thrust chambers for	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters p 8 N87-20373  RACHNIKOY, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel p 148 A87-34345  The synthesis of the power transmission channel for a satellite solar power station p 75 A87-35799  RADKE-MITCHELL, LYN  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984] p 50 A87-38763  RADKE, KATHLEEN p 50 A87-38763  RADKE, KATHLEEN p 111 A87-31463  RAHMET-SAMII, Y.  Antenna Technology Shuttle Experiment (ATSE) p 87 N87-24508  RAJAN, S. D.  A hybrid nonlinear programming method for design optimization p 7 A87-35718  RAMBAUT, PAUL C.  Foods and nutrition in space  [SAE PAPER 860926] p 47 A87-38716  RANKIN, J. GARY  Thermal test results of the two-phase thermal bus technology demonstration loop  [AIAA PAPER 87-1627] p 44 A87-43125  RANTANEN, R.  Contamination assessment for OSSA space station IOC payloads  [NASA-CR-4091] p 53 N87-26086  RASMUSSEN, DARYL N.  Life Sciences Research Facility automation requirements and concepts for the Space Station  [SAE PAPER 860970] p 50 A87-38752  RASMUSSEN, R. D.  MAX: A space station computer option
PIPPIN, H. GARY  Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206 PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures [AD-A179459] p 34 N87-23683 PITT, RICHARD p 36 N87-24680 PLAGNE, A.  The high performance solar array GSR3 p 81 N87-28972 PLAMET, WALTER Planning for future operational sensors and other priorities [NOAA-NESDIS-30] p 130 N87-25560 PLEVIN, JOHN Space Station opportunity for UK in earth sensing p 152 A87-41678 PLUMAT, Y.  Dynamic analysis of direct television satellite TV-SAT/TDF.1 p 86 N87-20360 PLUMAT, S. E.  A polar platform for the remote sensing needs of ecology and agriculture - A view from the U.K.  POELSTRA, J.  A study of fluid transfer management in space [FTMS-RPT-006] p 97 N87-26058 POH, S.  Modified independent modal space control method for active control of flexible systems [NASA-CR-181165] p 34 N87-23980 A comparison between IMSC, PI and MIMSC methods in controlling the vibration of flexible systems [NASA-CR-181166] p 36 N87-25605 Effect of bonding on the performance of a piezoactuator-based active control system [NASA-CR-181414] p 74 N87-29713 Optimum shape control of flexible beams by	PRADEEP, S.  Stability of time varying linear systems  PARLL, JOHN S., JR.  Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASAD, VENKATESH  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures [NASA-CR-180317]  PRATT, MARTIN L  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860988]  PREISS, H.  Columbus Life Support System and its technology development  [SAE PAPER 860966]  PREJEAN, STEPHEN E.  Space Station personal hygiene study  [SAE PAPER 860931]  PREMACK, TIMOTHY  Control of robot manipulator compliance  p 100  PREISER, F. C.  Magnetic refrigeration for space platforms  [SAE PAPER 861724]  PREUMONT, ANDRE  Spillover stabilization and decentralized modal control of large space structures  [AIAA PAPER 87-0903]  PRICE, C. R.  Track and capture of the orbiter with the space station remote manipulator system  [NASA-TM-89221]  PRICE, DONALD F.  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984]  PSO A87-38763  PRICE, HAROLD G.  Proven, long-life hydrogen/oxygen thrust chambers for space station repose station propulsion  p 98 N87-26133	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters p 8 N87-20373  RACHNIKOY, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel p 148 A87-34345  The synthesis of the power transmission channel for a satellite solar power station p 75 A87-35799  RADKE-MITCHELL, LYN  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984] p 50 A87-38763  RADKE, KATHLEEN p 50 A87-38763  RADKE, KATHLEEN p 111 A87-31463  RAHMET-SAMII, Y.  Antenna Technology Shuttle Experiment (ATSE) p 87 N87-24508  RAJAN, S. D.  A hybrid nonlinear programming method for design optimization p 7 A87-35718  RAMBAUT, PAUL C.  Foods and nutrition in space  [SAE PAPER 860926] p 47 A87-38716  RANKIN, J. GARY  Thermal test results of the two-phase thermal bus technology demonstration loop  [AIAA PAPER 87-1627] p 44 A87-43125  RANTANEN, R.  Contamination assessment for OSSA space station IOC payloads  [NASA-CR-4091] p 53 N87-26086  RASMUSSEN, DARYL N.  Life Sciences Research Facility automation requirements and concepts for the Space Station  [SAE PAPER 860970] p 50 A87-38752  RASMUSSEN, R. D.  MAX: A space station computer option  p 116 N87-29146
PIPPIN, H. GARY  Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206 PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures [AD-A179459] p 34 N87-23683 PITT, RICHARD p 36 N87-24680 PLAGNE, A.  The high performance solar array GSR3 p 81 N87-28972 PLANET, WALTER Planning for future operational sensors and other priorities [NOA-NESDIS-30] p 130 N87-25560 PLEVIN, JOHN Space Station opportunity for UK in earth sensing p 152 A87-41678 PLUMAT, Y.  Dynamic analysis of direct television satellite TV-SAT/TDF-1 p 86 N87-20360 PLUMMER, S. E.  A polar platform for the remote sensing needs of ecology and agriculture - A view from the U.K.  POELSTRA, J.  A study of fluid transfer management in space [FTMS-RPT-006] p 97 N87-26058 POH, S.  Modified independent modal space control method for active control of flexible systems [NASA-CR-181156] p 34 N87-23980 A comparison between IMSC, PI and MIMSC methods in controlling the vibration of flexible systems [NASA-CR-181156] p 36 N87-25605 Effect of bonding on the performance of a piezoactuator-based active control system [NASA-CR-181141] p 74 N87-29713 Optimum shape control of flexible beams by piezo-electric actuators	PRADEEP, S.  Stability of time varying linear systems  PRALL, JOHN S., JR. Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276] PRASAD, VENKATESH  Substructure analysis using applications of force to linear and nonlinear structures [NASA-CR-180317] PRATT, MARTIN L  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860988] PREISS, H.  Columbus Life Support System and its technology development  [SAE PAPER 860966] PREJEAN, STEPHEN E.  Space Station personal hygiene study  [SAE PAPER 860931] PREMACK, TIMOTHY Control of robot manipulator compliance  P 100 A87-3579  PREUMONT, ANDRE  Spillover stabilization and decentralized modal control of large space structures  [AIAA PAPER 87-0903] PRICE, C. R. Track and capture of the orbiter with the space station remote manipulator system [NASA-TM-89221] PRICE, DONALD F.  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984] PRICE, HAROLD G. Proven, long-life hydrogen/oxygen thrust chambers for space station propulsion PRICE, LARRY	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters p8 N87-20373  RACHNIKOV, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel p148 A67-34345  The synthesis of the power transmission channel for a satellite solar power station p75 A87-35799  RADKE-MITCHELL, LYN  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984] p50 A87-38763  RADKE, KATHLEEN  Head-ported display analysis for Space Station applications p111 A87-31463  RAHMET-SAMII, Y.  Antenna Technology Shuttle Experiment (ATSE) p87 N87-24508  RAJAN, S. D.  A hybrid nonlinear programming method for design optimization p7 A87-35718  RAMBAUT, PAUL C.  Foods and nutrition in space  [SAE PAPER 860926] p47 A87-38716  RANEY, WILLIAM P.  The Space Station overview p168 A87-41571  RANKIN, J. GARY  Thermal test results of the two-phase thermal bus technology demonstration loop  [AIAA PAPER 87-1627] p44 A87-43125  RANTANEN, R.  Contamination assessment for OSSA space station IOC payloads  (NASA-CR-4091] p53 N87-26086  RASMUSSEN, DARYL N.  Life Sciences Research Facility automation requirements and concepts for the Space Station  [SAE PAPER 860970] p50 A67-38752  RASMUSSEN, R. D.  MAX: A space station computer option  p116 N87-29146
PIPPIN, H. GARY  Structure-property relationships in polymer resistance to atomic oxygen p 106 A87-38642 Comments on the interaction of materials with atomic oxygen p 110 N87-26206 PISTER, KARL S.  An integrated, optimization-based approach to the design and control of large space structures [AD-A179459] p 34 N87-23683 PITT, RICHARD p 36 N87-24680 PLAGNE, A.  The high performance solar array GSR3 p 81 N87-28972 PLAMET, WALTER Planning for future operational sensors and other priorities [NOAA-NESDIS-30] p 130 N87-25560 PLEVIN, JOHN Space Station opportunity for UK in earth sensing p 152 A87-41678 PLUMAT, Y.  Dynamic analysis of direct television satellite TV-SAT/TDF.1 p 86 N87-20360 PLUMAT, S. E.  A polar platform for the remote sensing needs of ecology and agriculture - A view from the U.K.  POELSTRA, J.  A study of fluid transfer management in space [FTMS-RPT-006] p 97 N87-26058 POH, S.  Modified independent modal space control method for active control of flexible systems [NASA-CR-181165] p 34 N87-23980 A comparison between IMSC, PI and MIMSC methods in controlling the vibration of flexible systems [NASA-CR-181166] p 36 N87-25605 Effect of bonding on the performance of a piezoactuator-based active control system [NASA-CR-181414] p 74 N87-29713 Optimum shape control of flexible beams by	PRADEEP, S.  Stability of time varying linear systems  PARLL, JOHN S., JR.  Thermal and dynamical effects on electrodynamic space tethers  [AD-A180276]  PRASAD, VENKATESH  Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures [NASA-CR-180317]  PRATT, MARTIN L  An evolutionary approach to the development of a CELSS based air revitalization system  [SAE PAPER 860988]  PREISS, H.  Columbus Life Support System and its technology development  [SAE PAPER 860966]  PREJEAN, STEPHEN E.  Space Station personal hygiene study  [SAE PAPER 860931]  PREMACK, TIMOTHY  Control of robot manipulator compliance  p 100  PREISER, F. C.  Magnetic refrigeration for space platforms  [SAE PAPER 861724]  PREUMONT, ANDRE  Spillover stabilization and decentralized modal control of large space structures  [AIAA PAPER 87-0903]  PRICE, C. R.  Track and capture of the orbiter with the space station remote manipulator system  [NASA-TM-89221]  PRICE, DONALD F.  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984]  PSO A87-38763  PRICE, HAROLD G.  Proven, long-life hydrogen/oxygen thrust chambers for space station repose station propulsion  p 98 N87-26133	RAASCH, W.  Multi-axis vibration tests on spacecraft using hydraulic exciters p 8 N87-20373  RACHNIKOY, A. V.  Shape control of the directional pattern in a microwave-beam power transmission channel p 148 A87-34345  The synthesis of the power transmission channel for a satellite solar power station p 75 A87-35799  RADKE-MITCHELL, LYN  A membrane-based subsystem for very high recoveries of spacecraft waste waters  [SAE PAPER 860984] p 50 A87-38763  RADKE, KATHLEEN p 50 A87-38763  RADKE, KATHLEEN p 111 A87-31463  RAHMET-SAMII, Y.  Antenna Technology Shuttle Experiment (ATSE) p 87 N87-24508  RAJAN, S. D.  A hybrid nonlinear programming method for design optimization p 7 A87-35718  RAMBAUT, PAUL C.  Foods and nutrition in space  [SAE PAPER 860926] p 47 A87-38716  RANKIN, J. GARY  Thermal test results of the two-phase thermal bus technology demonstration loop  [AIAA PAPER 87-1627] p 44 A87-43125  RANTANEN, R.  Contamination assessment for OSSA space station IOC payloads  [NASA-CR-4091] p 53 N87-26086  RASMUSSEN, DARYL N.  Life Sciences Research Facility automation requirements and concepts for the Space Station  [SAE PAPER 860970] p 50 A87-38752  RASMUSSEN, R. D.  MAX: A space station computer option  p 116 N87-29146

DATUET JAMES E	RHEA, JOHN	ROSENDHAL, JEFFREY D.
RATLIFF, JAMES E.  FDMA system design and analysis for Space Station	Space Station - All change? p 154 A87-50792	A crisis in the NASA space and earth sciences
p 85 A87-45483	RHODES, G. D.	programme p 112 A87-37966 ROSS, SUSAN E.
RAU, TIMOTHY R.  Technical and Management Information System	Environmental avoidance concepts for steerable Space Station radiators	Rendezvous and docking tracker
(TMIS)	[SAE PAPER 861831] p 41 A87-32665	[AAS PAPER 86-014] p 133 A87-32733
[AIAA PAPER 87-2217] p 114 A87-48600	RHODES, MARVIN D.	ROSSIER, ROBERT N.  Nuclear powered submarines and the Space Station -
RAULT, R.	Deployable geodesic truss structure INASA-CASE-LAR-13113-11 p 36 N87-25492	A comparison of ECLSS requirements
Ariane transfer vehicle (ATV) to supply Space Station [AIAA PAPER 87-1862] p 152 A87-45257	[NASA-CASE-LAR-13113-1] p 36 N87-25492 Preloaded space structural coupling joints	[SAE PAPER 860945] p 48 A87-38732
RAY, ART J.	[NASA-CASE-LAR-13489-1] p 38 N87-27713	ROTH, H. Study on investigation of the attitude control of large
Rendezvous and docking tracker	RICE, JOHN R.	flexible spacecraft. Phase 1, volume 1: Technical report
[AAS PAPER 86-014] p 133 A87-32733	Planning for unanticipated satellite servicing telephorations p.118 A87-33048	[ESA-CR(P)-2361-VOL-1] p 73 N87-27706
RAY, C. D. Status of the Space Station environmental control and	totoporations	ROTT, M.  Micrometeorite exposure of solar arrays
life support system design concept	Optimum mix of passive and active control of space	p 82 N87-28982
[SAE PAPER 860943] p 48 A87-38730	structures p 65 N87-22714	ROUX, CH.
RAY, RODERICK J.  A membrane-based subsystem for very high recoveries	RICHARZ, H. P.	Computer simulation of deployment p 10 N87-29002
of spacecraft waste waters	The evolution of a serviceable EURECA [MBB-UR-E-923/86] p 121 N87-26841	RUDEV, A. I.
[SAE PAPER 860984] p 50 A87-38763	RICHTER G. PAUL	Legal problems concerning manned space flight
RAYMUS, STEVEN D.  Development of a standard connector for orbital	Proven, long-life hydrogen/oxygen thrust chambers for	p 151 A87-40339
replacement units for serviceable spacecraft	space station propulsion p 98 N87-26133	RUDIGER, C. E.  Science and payload options for animal and plant
p 40 N87-29864	RIEMER, DAVID H.  Space station experiment definition: Long term cryogenic	research accommodations aboard the early Space
RAZZAQ, ZIA Substructure analysis using NICE/SPAR and	fluid storage p 94 N87-21144	Station
Substructure analysis using NICE/SPAR and applications of force to linear and nonlinear structures	RIGSBY, JOHN M.	[SAE PAPER 860953] p 164 A87-38740
[NASA-CR-180317] p 38 N87-27260	Habitability issues for the Science Laboratory Module	RUDIGER, CARL E.  Special considerations in outfitting a space station
READ, J. Y.	[SAE PAPER 860971] p 50 A87-38753	module for scientific use
Complex system monitoring and fault diagnosis using communicating expert systems p 119 A87-40363	RIMROTT, F. P. J.  Global treatment of energy dissipation effects for	[SAE PAPER 860956] p 164 A87-38741
REDD. L. R.	multibody satellites p 62 A87-51610	RUDLAND, R. S.  On-orbit cryogenic fluid management experimental data
Propulsion recommendations for space station free	ROBERTS, G.	requirements using referee fluids
flying platforms p 98 N87-26129	A microgravity isolation mount p 161 N87-29861	[AIAA PAPER 87-1559] p 90 A87-44832
REDDY, A. S. S. R.  The dynamics and control of large flexible space	ROBERTSON, ANDREW R.	RULEY, D. N.
structures X, part 1	Development of precision structural joints for large space structures p 28 N87-20374	Optimization of a program of experiments in connection with the operational planning of studies carried out with
[NASA-CR-181287] p 73 N87-27712	ROBINSON, A. A.	a spacecraft p 148 A87-34208
REED, D. K. SAFE/DAE: Modal test in space p 77 N87-20584	A microgravity isolation mount p 161 N87-29861	Optimizing experimental programs in operational
DEEVES MIRRAY	ROBSON, R. R.	planning of research carried out from spacecraft p 160 N87-29553
Evaluation of the infrared test method for the Olympus	Automatic charge control system for geosynchronous satellites p 87 N87-26960	RUPPE, HARRY O.
thermal balance tests p 44 A87-46682	ROCHON, BRIAN V.	Thoughts on Europe's future in space
REGAL, DAVID M.  Human performance in space p 162 A87-33021	Crew activity and motion effects on the space station	p 151 A87-41219
DEICHERT R G	p 165 N87-22744	RUSAKOV, M. M. Expected size of a crater resulting from the impact of
Space launcher upper stages - Design for mission	RODDEN, J. J.  Vibration isolation for line of sight performance	a micrometeorite p 119 A87-41870
versatility and/or orbital operation p 132 A87-32474 REICHERT, RUDI G.	improvement p 67 N87-22742	RUSH, T.
Europe prepares for manned orbited operations	RODRIGUEZ, G.	Analysis of Intelsat V flight data [AIAA PAPER 87-0784] p 16 A87-33679
p 151 A87-39594	Static shape control for flexible structures [SAE PAPER 861822] p 13 A87-32658	[,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
REICHL, KARL O., JR.  Computer modeling of high-voltage solar array	ROEBELEN, GEORGE J.	RUSSELL, W. C.  Nonlinear transient analysis of joint dominated
experiment using the NASCAP/LEO (NASA Charging	Regenerable non-venting thermal control subsystem for	structures
Analyzer Program/Low Earth Orbit) computer code	extravehicular activity [SAF PAPER 860947] p 42 A87-38734	[AIAA PAPER 87-0892] p 17 A87-33709
[AD-A182589] p 81 N87-28186	[SAE PAPER 860947] p 42 A87-38734 ROEBELEN, GEORGE J., JR.	High speed simulation of multi-flexible-body systems
REINHARTZ, K. Space 2000 in Europe p 159 N87-29024	Maintenance components for Space Station long life	with large rotations [AIAA PAPER 87-0930] p 57 A87-33730
BEITZ G	fluid systems	Dynamics of trusses having nonlinear joints
The problem of radiation exposure in the Space	[SAE PAPER 861005] p 89 A87-38778 ROGERS, LESLIE J. A.	p 32 N87-22724
Station [DGLR PAPER 86-175] p 153 A87-48157	The next step for the MMU - Capabilities and	RUSSO, GENNARO
REMPT, RAYMOND D.	enhancements	Tether system and controlled gravity [AAS PAPER 86-240] p 124 A87-38573
Production of a beam of ground state oxygen atoms	[SAE PAPER 861013] p 160 A87-38783	RUTLEDGE. SHARON
of selectable energy p 139 A87-38624	ROGERS, LYNN Optimum mix of passive and active control of space	An evaluation of candidate oxidation resistant materials
RENDER, H.  SAGA: A project to automate the management of	structures p 65 N87-22714	for space applications in LEO [NASA-TM-100122] p 107 N87-25480
software production systems	ROGERS, R. P.	[NASA-TM-100122] p 107 N87-25480 Neutral atomic oxygen beam produced by ion charge
[NASA-CR-180276] p 10 N87-27412	A model for the estimation of the operations and utilisation costs of an international space station	exchange for Low Earth Orbital (LEO) simulation
RENMAN, RONALD E.  An evaluation of advanced extravehicular crew	p 168 A87-42267	p 131 N87-26188
enclosures	ROLAND, ALEX	An evaluation of candidate oxidation resistant
[SAE PAPER 861009] p 134 A87-38781	We shouldn't build the Space Station now p 169 A87-46875	materials p 110 N87-26203
RENNER, U.  Demands imposed on a surface tension propellant tank	ROLFE, E. J.	RYAN, ROBERT S.  Structural Dynamics and Control Interaction of Flexible
due to refuellability in the microgravity environment of outer	Proceedings of the European Symposium on Polar	Structures
space	platform Opportunities and Instrumentation for	[NASA-CP-2467-PT-1] p 65 N87-22702
[DGLR PAPER 86-104] p 88 A87-36756	Remote-Sensing (ESPOIR) [FSA-SP-266] p 128 N87-20621	Structural Dynamics and Control Interaction of Flexible
RETICCIOLI, M.  Thermal-electrical dynamical simulation of spacecraft	[ESA-SP-266] p 128 N87-20621 ROMERO, E.	Structures [NASA-CP-2467-PT-2] p 66 N87-22729
solar array p 83 N87-29004	A study of fluid transfer management in space	(ואחסחיטריביזטריו וייבן איניטריון) איני איניינייניין
RETZI AFF. SANDRA E.	[FTMS-RPT-006] p 97 N87-26058	e
A membrane-based subsystem for very high recoveries	ROMERO, JAMES M.  Large space systems technology and requirements	S
of spacecraft waste waters [SAE PAPER 860984] p 50 A87-38763	p 3 N87-24500	SAGAN CARI
PEN ET R	ROSE, L. J.	SAGAN, CARL Prospects for space science
MARECS and ECS anomalies: Attempt at insulation	Propulsion recommendations for space station free flying platforms p 98 N87-26129	[AAS PAPER 86-106] p 170 A87-53085
defect production in Kapton p 82 N87-28980	ROSE, T.	SAINZ, M.
REUTER, JAMES L.  Space Station environmental control and life support	Optimal placement of excitations and sensors for	Analysis and implementation of automation aspects in
system distribution and loop closure studies	verification of large dynamical systems	the Columbus and Hermes end to end systems [AIAA PAPER 87-2210] p 154 A87-48595
[SAE PAPER 860942] p 48 A87-38729	[AIAA PAPER 87-0782] p 19 A87-33755 ROSE, T. L.	SAITO, M.
DEVOA DICUADO D	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	the second secon

Structural dynamics system model reduction p 32 N87-22727

status

Japanese Experiment Module (JEM) preliminary design status p 151 A87-41570

REYSA, RICHARD P.
Results on reuse of reclaimed shower water
[SAE PAPER 860983] p 50

p 50 A87-38762

SATOU, S.

SATTERTHWAITE, ROBERT E.

[NASA-TM-100488]

Concept study of regenerable carbon dioxide removal

p 46 A87-32544

p 103 N87-29593

and oxygen recovery system for the Space Station

Space Station end effector strategy study

SAITOU. M. SAUER, R. L. SCHNEIDER, STEVEN J. Status of Japanese Experiment Module design Integrated waste and water management system Space station propulsion system technology [NASA-TM-100108] ISAE PAPER 860996] p 145 A87-32531 p 97 N87-25422 SAUER, RICHARD L. SCHOCK, RICHARD W. An enclosed hangar concept for large spacecraft Quality requirements for reclaimed/recycled water Solar array flight dynamic experiment servicing at Space Station [NASA-TM-58279] p 146 A87-32534 [AAS PAPER 86-050] p 75 A87-32747 SAKAMAKI, MASAMORI SAVAGE, TERRY R. Solar array flight dynamic experiment Model study of simplex masts p 144 A87-32339 An operations management system for the Space p 78 N87-22722 SAKAMOTO, N. Station p 112 A87-40358 SCHOLTZ, R. Mission scheduling expert system and its space station SAW, KONG C. GPS applications to the Space Station annlications Reduced modeling and analysis of large repetitive space [AIAA PAPER 87-2221] p 136 A87-45525 p 7 A87-48602 structures via continuum/discrete concepts SAKATANI, YOSHIAKI SCHRANTZ, P. R. p 19 A87-35327 Development of full scale deployable CFRP truss for Analysis of Intelsat V flight data [AIAA PAPER 87-0784] space structure p 25 A87-51793 Concept study of regenerable carbon dioxide removal p 16 A87-33679 SAKURAI, YASUSHI SCHREINER, K. E. and oxygen recovery system for the Space Station A thermally-pumped heat transport system Control considerations for high frequency, resonant, p 46 A87-32544 p 40 A87-32369 power processing equipment used in large systems [NASA-TM-89926] SAWDON, F. E. SALAMA, M. Design of a polar platform with an earth observation p 68 N87-23690 Optimal placement of excitations and sensors for baoload SCHUNK, RICHARD G. p 122 A87-32538 verification of large dynamical systems SAZONOV. V. V. Space Station environmental control and life support AIAA PAPER 87-0782] Gravity-gradient stabilization of the Salyut 6-Soyuz p 19 A87-33755 system distribution and loop closure studies SALAME, KARIM G. orbital complex [SAE PAPER 860942] p 48 A87-38729 p 147 A87-32801 Wave propagation in transversely isotropic continuum SCARGLE, JEFFREY D. SCHUSTER, JOHN R models of LSS (Large Space Structures) An astrometric facility for planetary detection on the Evaluation of cryogenic system test options for the OTV [AD-A177271] p 30 N87-22256 p 127 A87-50750 on-orbit propellant depot SALIMOV, G. R. An astrometric facility for planetary detection on the p 90 A87-43027 Effect of crew motions on the spatial position of a space station Long term cryogenic storage facility systems study snacecraft p 152 A87-41954 NASA-TM-89436] p 128 N87-20841 p 94 N87-21143 SALOMONSON, V. V. SCARLOTTI, R. D. SCHWARTZ, D. Preliminary system concepts for MODIS - A moderate Space station experiment definition: Long-term Space Station gas-grain simulation facility - Application resolution imaging spectrometer for EOS cryogenic fluid storage to exobiology p 127 A87-53002 p 126 A87-44186 [NASA-CR-40721 p 97 N87-24641 SALONEN, ERKKI SCHAEFER, B. SCHWARTZ M. R Integrated air revitalization system for Space Station Design of a beacon receiving system for the Olympus Study on investigation of the attitude control of large [SAE PAPER 860946] p 86 A87-50157 flexible spacecraft. Phase 1, volume 1: Technical report [ESA-CR(P)-2361-VOL-1] p 73 N87-27706 p 48 A87-38733 SCHWARZ, B. SAMSON, P. The capabilities of Eureca thermal control for future Aerospatiale solar arrays, in orbit performance Study on investigation of the attitude control of large p 159 N87-28988 mission scenarios flexible spacecraft. Phase 2, volume 1: Executive SANDERS, FRED G. [SAE PAPER 860936] summarv p 42 A87-38725 Bi-stem gripping apparatus [NASA-CASE-MFS-28185-1] [ESA-CR(P)-2361-VOL-1] SCHWEICKERT, THOMAS F. p 73 N87-27707 SCHAMEL, GEORGE C., II Propellant tank resupply system p 107 N87-25586 SANDRIDGE, CHRIS A. A comparison of active vibration control techniques -[AD-D0125591 p 93 N87-20375 Output feedback vs optimal control Accuracy of derivatives of control performance using a SCHWENDE, MANFRED reduced structural model [AIAA PAPER 87-0904] Status and tendencies for low to medium thrust [AIAA PAPER 87-0905] p 57 A87-33714 An analytical and experimental investigation of output propulsion systems SANG. O. TRAN feedback vs. linear quadratic regulator [IAF PAPER 86-162] p 90 A87-42680 Vapor fragrancer [AIAA PAPER 87-2390] p 61 A87-50474 SCOFIELD, HAROLD N. NASA-CASE-LAR-13680-1] SCHAPERY, R. A. p 165 N87-25561 Structural Dynamics and Control Interaction of Flexible SANKAR T. S. Dynamic response of a viscoelastic Timoshenko beam Structures Optimization of aerospace structures subjected to [AIAA PAPER 87-0890] p 16 A87-33708 INASA-CP-2467-PT-11 p 65 N87-22702 random vibration and fatigue constraints SCHEDLER, ARMIN Structural Dynamics and Control Interaction of Flexible p 29 N87-20599 Fiber composites in satellites Structures SANTORU, J. IMBB-UD-492/861 p 107 N87-25430 [NASA-CP-2467-PT-2] p 66 N87-22729 Automatic charge control system for geosynchronous SCHEER, STEVEN A. SCOTT-MONCK, JOHN satellites p 87 N87-26960 Crew activity and motion effects on the space station Advanced photovoltaic solar array design assessment SANTOS-MASON, B. p 165 N87-22744 Selected materials issues associated with Space SCHEID, R. E., JR. p 80 N87-26429 SEARS, WILLIAM J. Station p 105 A87-32061 Static shape control for flexible structures [SAE PAPER 861822] p 13 SANTOSMASON, B. Physiological aspects of EVA p 13 A87-32658 ISAE PAPER 8609911 Review of Low Earth Orbital (LEO) flight experiments p 164 A87-38768 SCHELKOPF, J. D. Science Research Facilities - Versatility for Space SEETHARAMABHAT, M. p 131 N87-26174 SARIGUL, NESRIN Dynamics of an actively controlled flexible Earth Station Progress on the Ohio State University Get Away Special G-0318: DEAP p 170 NRZ-20214 [SAE PAPER 860958] observation satellite p 71 N87-25356 p 119 A87-38742 p 170 N87-20311 SCHILDT, U. SERAFINI, JOHN S. SARLO, L. Spacecraft qualification using advanced vibration and Effect of nozzle geometry on the resistojet exhaust The hardware/software architecture of the Columbus modal testing techniques p 27 N87-20368 ressurized module element [AIAA PAPER 87-2121] SCHLUDE, F. p 62 A87-52252 [AIAA PAPER 87-2211] p 154 A87-48596 European utilization aspects studies SERWAY, R. A. SARRAIL, D. p 156 N87-20624 Frequency dispersion in the admittance of the polycrystalline Cu2S/CdS solar cell p 5 A87-29133 On the possibility of a several-kilovolt differential charge SCHMID, M. p 5 A87-29133 in the day sector of a geosynchronous orbit The extendable and retractable mast as supporting tool p 158 N87-26953 for rigid solar arrays p 39 N87-29012 Dynamic modeling and optimal control design for large MARECS and ECS anomalies: Attempt at insulation SCHMIDT, GEORGE R. flexible space structures p 26 N87-20358 defect production in Kapton p 82 N87-28980 The impact of integrated water management on the SHAPLAND, D. J. SARYCHEV, V. A. Space Station propulsion system The Columbus program: An overview Gravity-gradient stabilization of the Salyut 6-Soyuz [AIAA PAPER 87-1864] p 91 A87-45259 p 156 N87-20623 orbital complex p 147 A87-32801 SHARKEY, J. P. SCHMIDT, J. T. SASAKI, H. Active vibration damping of flexible structures using the Distributed control using linear momentum exchange Development of the electrical power subsystem for the devices [NASA-TM-100308] aveling wave approach electric propulsion experiment onboard the Space Flyer p 71 N87-25360 SCHMIDT, ROSEMARY p 70 N87-24521 Unit (SFU) SHARKEY, JOHN P.
A TREETOPS simulation of the Hubble Space [AIAA PAPER 87-1040] Space station active thermal control system modelling p 76 A87-39628 [AIAA PAPER 87-1468] SASAKI S p 43 A87-43003 Telescope-High Gain Antenna interaction Preliminary results of CHARGE-2 tethered payload SCHMIT, L. A. p 9 N87-22735 p 121 A87-32521 Control augmented structural synthesis with transient SHARMA, R. SATO S response constraints Actuators for actively controlled space structures [AIAA PAPER 87-0749] Design consideration of mechanical and deployment p 56 A87-33573 p 59 A87-42816 roperties of a collable lattice mast p 12 A87-32340 SCHMUESER D W

Effect of transverse shearing forces on buckling and

p 105 A87-33639

p 82 N87-28981

postbuckling of delaminated composites under

Micrometeorite impact on solar panels

compressive loads

SCHNEIDER E.

[AIAA PAPER 87-0877]

p 17 A87-33709

p 32 N87-22724

p 32 N87-22725

SHAW, F. H.

structures

techniques

[AIAA PAPER 87-08921

Nonlinear transient analysis of joint dominated

Equivalent beam modeling using numerical reduction

Dynamics of trusses having nonlinear joints

Design of a mixed fleet transportation system to low

Earth orbit. Volume 1: Executive summary. Volume 2:

Near-term shuttle replacement. Volume 3: Heavy-lift cargo

vehicle. Volume 4: Advanced technology shuttle

Advanced technology for extended endurance alkaline

p 75 A87-33787

SHAWCROSS, PAUL J.

SHEIBLEY, D. W.

SHEIBLEY, DEAN W.	p 00 707-40210
Status of space station power system p 84 N87-29915	Variable structure controller design for spacecraft
SHELTON, K. W. Antenna systems and RF coverage for the Space Station p.2 A87-45523	nutation damping p 58 A87-39958 SIRLIN, SAMUEL W.
HENHAR, J.	The Softmounted Inertially Reacting Pointing System (SIRPNT)
On-line identification and attitude control for SCOLE [AIAA PAPER 87-2459] p 61 A87-50505	[AAS PAPER 86-007] p 56 A87-32732
SHIRLIYA YOSHIKAZU	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817
Laboratory simulation of plasma interaction with high	for the Space Shuttle Orbiter p 59 A87-42817  SJOLANDER, GARY W.
voltage solar array p 145 A87-32388	Martin Marietta atomic oxygen beam facility
SHIH, CHOON-FOO  Verification of large beam-type space structures	p 139 A87-38622
p 31 N87-22712	Martin Marietta atomic oxygen Low Earth Orbit (LEO)
SHIM, JAEDONG	simulation p 142 N87-26204
Gradient-based combined structural and control optimization p 21 A87-40866	SKIDMORE, RICHARD A.  A simulation capability for future space flight
optimization p 21 A87-40000 SHIMADA, MASAAKI	[SAE PAPER 861784] p 99 A87-32633
Communication missions for geostationary platforms	SKINNER, G. K.
p 84 A87-34797 SHIMAMOTO, YOSHIHARU	Coded mask telescopes for X-ray astronomy p 123 A87-37785
A preliminary study on a linear inertial actuator for LSS	SKIRVIN, GLEN D.
control p 55 A87-32447	Military space station implications
HIMEMURA, ETSUJIRO	[AD-A180831] p 172 N87-26964
A consideration to vibration control for a large space structures p 54 A87-32441	SKOOG, A. I.  Columbus Life Support System and its technology
SHINKIN, VIACHESLAV PAVLOVICH	development
Structure and design of spacecraft	[SAE PAPER 860966] p 150 A87-38748
p 155 A87-51870 HIPLEY, J. W.	SKOWRONSKI, J. M.
The Mast Flight System dynamic characteristics and	Adaptive tracking of dynamical model by uncertain nonlinearizable spacecraft
actuator/sensor selection and location	[AIAA PAPER 87-0940] p 57 A87-33738
SHIRAKI, K.	SLATER, G. L.
Status of Japanese Experiment Module design	Robust multivariable control of large space structures using positivity p 59 A87-47810
p 145 A87-32531	using positivity p 59 Ab7-47610  Construction of positive real compensation for LSS
Japanese Experiment Module (JEM) preliminary design status p 151 A87-41570	control
SHIRAKI, KUNIAKI	[AIAA PAPER 87-2238] p 60 A87-50404
Development of exposed deck of Japanese experiment	SLAVIN, THOMAS J.  CELSS waste management systems evaluation
module p 145 A67-32532 SHOJI, TAKATOSHI	[SAE PAPER 860997] p 51 A87-38774
Preliminary experimental study on the oxygen separating	SLEMP, WAYNE S.
and concentrating system for CELSS p 46 A87-32455	Assessment of space environment induced microdamage in toughened composite materials
Development of carbon dioxide removal system - Experimental study of solid amines p 145 A87-32456	p 20 A87-38609
SHOWALTER, BARTON E.	SLEPUSHKIN, IURII VALENTINOVICH
Design of a mixed fleet transportation system to low	Structure and design of spacecraft p 155 A87-51870
Earth orbit. Volume 1: Executive summary. Volume 2: Near-term shuttle replacement. Volume 3: Heavy-lift cargo	SLOVIK, G.
vehicle. Volume 4: Advanced technology shuttle	Nuclear propulsion systems for orbit transfer based on
replacement p 5 N87-29583	the particle bed reactor
SHRIVASTAVA, S. K.  Dynamics of an actively controlled flexible Earth	[DE87-010060] p 99 N87-28405 SMITH, D. B.
observation satellite p 71 N87-25356	MAX: A space station computer option
SHRIVASTAVA, SHASHI K.	p 116 N87-29146
Stability of time varying linear systems	SMITH, GENE Data capture and processing
SHUMAN, B. M.	[AIAA PAPER 87-2203] p 113 A87-48588
Automatic charge control system for geosynchronous	SMITH, KERI ODA
satellites p 87 N87-26960	O-atom degradation mechanisms of materials p 141 N87-26178
SHUMATE, TIMOTHY P.  Microcrack resistant structural composite tubes for	SMITH MICHAEL D.
space applications p 106 A87-41022	Proposed application of automated biomonitoring for
SIBENER, STEVEN J.	rapid detection of toxic substances in water supplies for permanent space stations p 164 A87-40098
Dynamics of atom-surface interactions p 141 N87-26183	SMITH PAUL H.
SIEMERS, P. M., III	Problems in merging Earth sensing satellite data sets
The tethered satellite system for low density	[NASA-TM-87820] p 129 N87-22457
aerothermodynamics studies p 127 A87-52450 SIGNORELLI, JOEL	SMITH, R. E.  Upper and Middle Atmospheric Density Modeling
Wave propagation in periodic truss structures	Requirements for Spacecraft Design and Operations
[AIAA PAPER 87-0944] p 18 A87-33742	[NASA-CP-2460] p 64 N87-20665
	SMITH, TERENCE Remote Sensing Information Sciences Research Group:
SIGUIER, J. M.  MARECS and ECS anomalies: Attempt at insulation	Santa Barbara Information Sciences Research Group, year
SIGUIER, J. M.  MARECS and ECS anomalies: Attempt at insulation defect production in Kapton p 82 N87-28980	
MARECS and ECS anomalies: Attempt at insulation defect production in Kapton p 82 N87-28980 SIMON, WILLIAM E.	4
MARECS and ECS anomalies: Attempt at insulation defect production in Kapton p 82 N87-28980 SIMON, WILLIAM E. Manned spacecraft electrical power systems	4 [NASA-CR-181073] p 115 N87-24817
MARECS and ECS anomalies: Attempt at insulation defect production in Kapton p 82 N87-28980 SIMON, WILLIAM E. Manned spacecraft electrical power systems p 75 A87-37291 SIMONIAN. S. S.	4 [NASA-CR-181073] p 115 N87-24817 SMITH. W.
MARECS and ECS anomalies: Attempt at insulation defect production in Kapton p 82 N87-28980 SIMON, WILLIAM E. Manned spacecraft electrical power systems p 75 A87-37291 SIMONIAN, S. S. On a balanced passive damping and active vibration	[NASA-CR-181073] p 115 N87-24817  SMITH, W.  SAGA: A project to automate the management of software production systems
MARECS and ECS anomalies: Attempt at insulation defect production in Kapton p 82 N87-28980 SIMON, WILLIAM E. Manned spacecraft electrical power systems p 75 A87-37291 SIMONIAN, S. S. On a balanced passive damping and active vibration suppression of large space structures	4 [NASA-CR-181073] p 115 N87-24817  SMITH, W. SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412
MARECS and ECS anomalies: Attempt at insulation defect production in Kapton p 82 N87-28980  SIMON, WILLIAM E. P 75 A87-37291  SIMONIAN, S. S. On a balanced passive damping and active vibration suppression of large space structures  [AIAA PAPER 87-0901] p 19 A87-34701	[NASA-CR-181073] p 115 N87-24817  SMITH, W.  SAGA: A project to automate the management of software production systems  [NASA-CR-180276] p 10 N87-27412  SMITH, WILLIAM L.
MARECS and ECS anomalies: Attempt at insulation defect production in Kapton p 82 N87-28980 SIMON, WILLIAM E. Manned spacecraft electrical power systems p 75 A87-37291 SIMONIAN, S. S. On a balanced passive damping and active vibration suppression of large space structures	4 [NASA-CR-181073] p 115 N87-24817  SMITH, W. SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412

```
SMOLDERS, PETER
SINGH, R. P.
                                                                      Living in space: A handbook for space travellers
    Notes on implementation of Coulomb friction in coupled
                                                                                                          p 162 A87-33475
                                         p 67 N87-22746
  dynamical simulations
                                                                 SNODDY, WILLIAM C.
SINGH, S. K.
                                                                      Use of the Orbital Maneuvering Vehicle (OMV) for
    Comparison of different attitude control schemes for
                                                                     placement and retrieval of spacecraft and platforms
  large communications satellites
                                                                    AAS PAPER 86-041]
  [AIAA PAPER 87-2391]
                                         p 61 A87-50475
                                                                  SOBECK, CHARLIE
SINGH, SAHJENDRA N.
                                                                    Astronomic Telescope Facility: Preliminary systems definition study report. Volume 2: Technical description
    Robust nonlinear attitude control of flexible spacecraft
                                          n 60 A87-48273
                                                                                                         p 129 N87-22570
                                                                    [NASA-TM-89429-VOL-2] p 129 N87-22570
Astrometric Telescope Facility preliminary systems
definition study. Volume 1: Executive summary
                                               or spacecraft
                                                 A87-39958
                                                                                                         p 129 N87-22571
                                                                    [NASA-TM-89429-VOL-1]
                                                                  SOBIESKI, STANLEY
                                               nting System
                                                                      Mass storage systems for data transport in the early
                                                                    space station era 1992-1998
                                                 A87-32732
                                                                                                          p 115 N87-27443
                                                                    [NASA-TM-87826]
                                               inting system
                                                                  SOBOTTA, WERNER
                                                                      Control engineering tasks in the framework of the
                                                 A87-42817
                                                                    Columbus program
                                                                                                          p 158 N87-26842
                                                                    IMBB-UR-E-912/861
                                                 A87-38622
                                                                  SOFFEN, GERALD A.
                                                                    The human quest in space; Proceedings of the 
Twenty-fourth Goddard Memorial Symposium, Greenbelt,
                                               Orbit (LEO)
                                                 N87-26204
                                                                                                             p 2 A87-53082
                                                                    MD, Mar. 20, 21, 1986
                                                                  SOILEAU, K. M.
                                                                      Inadequacy of single-impulse transfers for path
                                                 A87-32633
                                                                                                            p 90 A87-41615
                                                                    constrained rendezvous
                                                                      Science Research Facilities - Versatility for Space
                                               my
                                                 A87-37785
                                                                    Station
                                                                                                           p 119 A87-38742
                                                                    [SAE PAPER 860958]
                                                                  SOLON, M.
                                                 N87-26964
                                                                      Nuclear propulsion systems for orbit transfer based on
                                                                     the particle bed reactor
                                               ts technology
                                                                                                            p 99 N87-28405
                                                                     DE87-0100601
                                                                  SOS. JOHN
                                               A87-38748
                                                                       Data storage systems technology for the Space Station
                                                                                                           p 113 A87-48587
                                               by uncertain
                                                                     [AIAA PAPER 87-2202]
                                                                     Mass storage systems for data transport in the early space station era 1992-1998
                                               7 A87-33738
                                                                                                           p 115 N87-27443
                                                                     [NASA-TM-87826]
                                               ace structures
                                                                   SOULIAC, M.
                                                                       SPOT/MEGS design and flight results obtained
                                               9 A87-47810
                                                                                                           p 103 N87-29009
                                               ation for LSS
                                                                   SOVEY, JAMES S.
                                                                       Preliminary performance characterizations of an
                                              O A87-50404
                                                                     engineering model multipropellant resistojet for space
                                                                      station application
                                               luation
                                                                                                             p 93 A87-50197
                                                                     [AIAA PAPER 87-2120]
                                               1 A87-38774
                                                                       A 2000-hour cyclic endurance test of a laboratory model
                                                                      multipropellant résistojet
                                               ent
                                                   induced
                                                                                                             p 96 N87-22237
                                                                     [NASA-TM-89854]
                                               erials
                                                                     Oxidation protection coatings for polymers
[NASA-CASE-LEW-14072-3] p 107 N87-23736
Preliminary performance characterizations of an
                                               0 A87-38609
                                                                     engineering model multipropellant resistojet for space
                                               5 A87-51870
                                                                     station application
[NASA-TM-100113]
                                                                                                             p 96 N87-23821
                                               nsfer based on
                                                                       Space station propulsion system technology
NASA-TM-1001081 p 97 N87-25422
                                                                      [NASA-TM-100108]
                                                                     Water-propellant resistojets for man-tended platforms
[NASA-TM-100110] p 98 N87-26135
                                               9 N87-28405
                                                                                                             p 98 N87-26135
                                                                    SPANGENBURG, RAY
                                               6 N87-29146
                                                                                                               p 1 A87-32116
                                                                        A question of gravity
                                                                    SPANGLER, L. H.
                                                                        High intensity 5 eV CW laser sustained 0-atom exposure
                                               3 A87-48588
                                                                      facility for material degradation studies
                                                                                                            p 105 A87-32060
                                               terials
                                                                        Mass spectrometers and atomic oxygen
                                                  N87-26178
                                                                                                            p 141 N87-26176
                                                                        High intensity 5 eV atomic oxygen source and Low Earth
                                               monitoring for
                                                                                                            p 141 N87-26186
                                                                      Orbit (LEO) simulation facility
                                                 r supplies for
                                               34 A87-40098
                                                                    SPENCER, MARK B.
                                                                        Use of lightweight composites for GAS payload tructures p 25 N87-20307
                                               ellite data sets
                                                                      structures
                                                                    SPENCER, PORTER A.
                                               9 N87-22457
                                                                        Space Station alpha joint bearing p 83 N87-29882
                                                                    SPONABLE, JESS M.
                                               nsity Modeling
                                                                        Electric propulsion for orbit transfer - A NAVSTAR case
                                               Operations
                                                                      study (Has electric propulsion's time come?)
[AIAA PAPER 87-0985] p 88
                                               4 N87-20665
                                                                                                             p 88 A87-38001
                                                                    SREENATHA, A. G.
                                               esearch Group:
                                                                      Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356
                                               rch Group, year
                                                                                                             p 71 N87-25356
                                                                    SRIDHAR, BANAVAR
                                               15 N87-24817
                                                                        Maximum likelihood identification using an array
                                                                                                               p 5 A87-32121
```

processor

solar array ST. JOHN, ROBERT H.

SRINIVASAMURTHY, N.

Design and fabrication of Stretched Rohini Satellite-1

Real-time simulation for Space Station

p 83 N87-29006

p 7 A87-37298

ST-PIERRE,	DANY
------------	------

Evaluation of the infrared test method for the Olympus thermal balance tests p 44 A87-46682

#### STAPF, R.

Study on investigation of the attitude control of large flexible spacecraft. Phase 1, volume 1: Technical report [ESA-CR(P)-2361-VOL-1] p 73 N87-27706

Study on investigation of the attitude control of large flexible spacecraft. Phase 2, volume 1: Executive summary

[ESA-CR(P)-2361-VOL-1]

p 73 N87-27707

STAR, JEFFREY L.

Remote Sensing Information Sciences Research Group: Santa Barbara Information Sciences Research Group, year

[NASA-CR-181073]

p 115 N87-24817

STARK, J. A.

Enhanced evaporative surface for two-phase mounting [SAE PAPER 860979] p 42 A87-38760

STATLER, RICHARD L.

Testing of materials for solar power p 107 A87-53946

STEDMAN, J. K.

Advanced fuel cell concepts for future NASA missions p 99 N87-29930

STEELS, R.

Modal-survey testing of the Olympus spacecraft p 152 A87-42266

STEIN, J. W.

Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222

STEINBERG, A. L.

The use of multidimensional scaling for facilities layout - An application to the design of the Space Station

p 118 A87-33003 Analysis of crew functions as an aid in Space Station

[SAE PAPER 860934]

p 163 A87-38724

STELLA, PAUL

Advanced photovoltaic solar array design assessment p 80 N87-26429

STEPANTSOV, V. I.

Evaluation of physical work capacity of cosmonauts aboard Salyut-6 station p 157 N87-20735

STEPHENS, MARK

SOT: A rapid prototype using TAE windows

p 114 N87-23161 STERN, P. H.

Space station integrated wall design and penetration damage control [NASA-CR-179165] p 39 N87-28581

STERN, S. A.

Inadequacy of single-impulse transfers for path constrained rendezvous p 90 A87-41615 p 90 A87-41615

STEVENS, CHRISTINE L. Liquid propellant tank ullage bubble deformation and

breakup in low gravity reorientation [AIAA PAPER 87-2021] p 92 A87-45360

STEVENS, N. J.

Spacecraft environment interaction investigation AD-A1791831 p 140 N87-23678

STEVENS, N. JOHN Modeling of environmentally induced transients within satellites

[AIAA PAPER 85-0387]

p 7 A87-41611 STEWART, W. F.

Magnetic refrigeration for space platforms [SAE PAPER 861724] p 118 A87-32613

STIDHAM, CURT

Neutral atomic oxygen beam produced by ion charge exchange for Low Earth Orbital (LEO) simulation

STOCKWELL, ALAN E.

p 131 N87-26188

Interdisciplinary analysis procedures in the modeling and control of large space-based structures p 22 A87-42678

STOCKWELL, BRIAN

Commercialization of space -The insurance implications p 166 A87-32460 STOEWER, H.

STOKER. C. R.

Space 2000 in Europe p 159 N87-29024 Space Station gas-grain simulation facility - Application

p 127 A87-53002 STOKES, LEBARIAN

An electromechanical attenuator/actuator for Space Station docking p 138 N87-29878 STONE, DENNIS A.

Advanced technology for the Space Station

STORNELLI, S.

p 120 A87-40353

Sampled nonlinear control for large angle maneuvers of flexible spacecraft p 71 N87-25358 STOWE, LARRY

Planning for future operational sensors and other priorities

NOAA-NESDIS-301 STRAMLER, J. H.

p 130 N87-25560

A comparison between space suited and unsuited reach envelopes p 47 A87-33013 STROHBEHN, K.

Configuration tradeoffs for the space infrared telescope facility pointing control system p 121 A87-32236

Space Infrared Telescope Facility/Multimission Modular Spacecraft Attitude Control System conceptual design [AAS PAPER 86-031] p 56 A87-32736

STUART, GARY M.

Computer simulation of on-orbit manned maneuvering unit operations

**ISAE PAPER 861783**]

p 47 A87-32632

p 42 A87-38725

p 140 N87-23066

p 96 N87-22003

p 20 A87-38609

STUCKEY, W. K.

Effects on advanced materials: Results of the STS-8 EOIM (Effects of Oxygen Interaction with Materials) experiment [AD-A182931] p 110 N87-29709

STUDER, P.

Actuators for actively controlled space structures D 59 A87-42816

STUEMPEL, D.

The capabilities of Eureca thermal control for future nission scenarios

[SAE PAPER 8609361 SÚ. SHIN-YI

Orbital debris environment resulting from future activities in space p 139 A87-44392

SUDHAKAR, M.

Design and fabrication of Stretched Rohini Satellite-1 solar array p 83 N87-29006

SUHOZA, J. P. Evaluation of carbon-carbon for space engine nozzle p 98 N87-26116

SULLIVAN, JAMES D.

A preliminary study of extended magnetic field structures in the ionosphere

INASA-CR-1810041

SULMEISTERS, TAL K. NERVA derived nuclear orbit transfer system p 92 A87-45439

[AIAA PAPER 87-2155]

SAGA: A project to automate the management of software production systems

[NASA-CR-180276] p 10 N87-27412

SUNDARARAJAN, N.

Robust controller synthesis for a large flexible space antenna p 84 A87-32235 SUNDBERG, GALE R.

Space Station 20-kHz power management and distribution system p 75 A87-36913 SUTTER, THOMAS R.

Dynamic and attitude control characteristics of an International Space Station

[AIAA PAPER 87-0931] p 57 A87-33731

SUZUKI. M.

Two-time-scale design of robust controllers for large structure systems p 12 A87-32443 SUZUKI, YOSHIAKI

Communication missions for geostationary platforms p 84 A87-34797

SWENSON, G. R.

Spacecraft ram glow and surface temperature p 10 N87-26205

SWITZER, COLLEEN A.

Coaxial tube array space characterization transmission line

[NASA-TM-89864] SYKES, GEORGE F.

Assessment of space environment induced microdamage in toughened composite materials

SZCZUR, MARTHA

TAE Plus: A conceptual view of TAE in the space station p 9 N87-23157

SZCZUR, MARTHA R.

Standards for the user interface - Developing a user [AIAA PAPER 87-2209] p 169 A87-48594

T

TABATA, MASAKI

Model study of simplex masts p 144 A87-32339 TACINA, R. R.

Conceptual design and integration of a Space Station resistojet propulsion assembly [AIAA PAPER 87-1860] p 91 A87-45256

TACINA, ROBERT R.

Conceptual design and integration of a space station resistojet propulsion assembly

p 93 N87-20378

Space station propulsion system technology INASA-TM-1001081 p 97 N87-25422

TAKAHARA, KENICHI

The design and development of a two-dimensional adaptive truss structure p 40 N87-29860 p 40 N87-29860 TAKAHASHI, MASAMI

Japanese experiment module data management and

communication system p 147 A87-32542 TAKAHASHI, TOSHIAKI Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method

TAKAMATSU, KIYOSHI

New concepts of deployable truss units for large space

[AIAA PAPER 87-0868]

p 14 A87-33632

p 42 A87-38725

p 144 A87-32334

TAKIKAWA, KUMIKO

Autonomous decentralized system concept for Space Station p 146 A87-32541

TAMAOKI, HIDEHIKO

A consideration to vibration control for a large space structures p 54 A87-32441

TAMBURINI P

The capabilities of Eureca thermal control for future

[SAE PAPER 860936]

TAMMA, KUMAR K. Reduced modeling and analysis of large repetitive space

structures via continuum/discrete concepts p 19 A87-35327

TANABE, TORU

System and operation analyses of OTV Network - A new space transportation concept p 145 A87-32475 TANAKA, JUNZO

Development of exposed deck of Japanese experiment module p 145 A87-32532

TANAKA, KIYOSHI

Development of fluid loop system for spacecraft

p 144 A87-32370

TANAKA, T.

Japanese data relay satellite system [AIAA PAPER 87-2199] p 154 A87-48585

TANAKA, TOSHIYUKI

Autonomous decentralized system concept for Space Station TANZER, H. J.

High capacity demonstration of honeycomb panel heat

SAE PAPER 861833] p 41 A87-32666

TAPPE, W. Nuclear propulsion systems for orbit transfer based on the particle bed reactor

[DE87-010060] p 99 N87-28405 TAYLOR, L. W.

Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE) structure

[AIAA PAPER 87-0895]

p 16 A87-33689 TAYLOR, L. W., JR.

Distributed parameter modeling of the structural

dynamics of the Solar Array Flight Experiment [AIAA PAPER 87-2460] p 25 A87-50506

TAYLOR, ROBERT L. An integrated, optimization-based approach to the design and control of large space structures

AD-A1794591 p 34 N87-23683 TAYLOR, ROY A. A space debris simulation facility for spacecraft materials evaluation p 11 A87-32058

TEFFT, E. C., BI Enhanced evaporative surface for two-phase mounting

[SAE PAPER 860979]

**TEGART, JAMES** Shuttle middeck fluid transfer experiment: Lessons p 95 N87-21158

TENNEY, DARREL R.

Composite tubes for the Space Station truss structure p 20 A87-38601 TEREN, FRED

Space station electric power system requirements and design [NASA-TM-89889]

p 96 N87-22001

TERUI, F. Low-authority control of large space structures by using

tendon control system [AIAA PAPER 87-2249] p 60 A87-50413

TERWILLIGER, R. SAGA: A project to automate the management of software production systems

[NASA-CR-180276]

p 10 N87-27412

p 42 A87-38760

Preliminary design, analysis, and costing of a dynamic

p 36 N87-25606

scale model of the NASA space station

[NASA-CR-4068]

#### **TEZUKA, HITOSHI**

VANKE, V. A. Dynamic characteristics of a vibrating beam with periodic TEZUKA. HITOSHI Shape control of the directional pattern in a p 32 N87-22726 variation in bending stiffness Development of exposed deck of Japanese experiment microwave-beam power transmission channel Space station structures and dynamics test program p 145 A87-32532 p 148 A87-34345 p 33 N87-22751 THIEME, G. The synthesis of the power transmission channel for a Study on investigation of the attitude control of large TRABANINO, RUDY p 75 A87-35799 satellite solar power station flexible spacecraft. Phase 1, volume 1: Technical report Space Station galley design VANSWIETEN, AAD p 73 N87-27706 p 119 A87-38722 [ESA-CR(P)-2361-VOL-1] ISAF PAPER 8609321 End effector development study. Volume 2: Service End Study on investigation of the attitude control of large Effector subsystem specification (SEESSPEC) TRIPPI. A. flexible spacecraft. Phase 2, volume 1: Executive Status of the RITA - Experiment on EURECA [FOK-TR-R-86-091-VOL-2] p 102 N87-24486 p 123 A87-38002 AIAA PAPER 87-0988] End effector development study, volume 1 p 73 N87-27707 [ESA-CR(P)-2361-VOL-1] TRIVEDI, DINESH J. p 102 N87-25336 [FOK-TR-R-86-091-VOL-1] Study on investigation of the attitude control of large An experimental study of transient waves in a plane End effector development study. Volume 3: flexible spacecraft, phase 3 arid structure Appendices p 73 N87-27709 p 102 N87-25337 [ESA-CR(P)-2361-VOL-4] p 18 A87-33741 [FOK-TR-R-86-091-VOL-3] [AIAA PAPER 87-0943] THOMIN. G. TRZCINSKI, E. VÄSILEVSKAIA, E. G. Experiences of CNES and SEP on space mechanisms Mass spectrometers and atomic oxygen Legal problems concerning manned space flight p 104 N87-29868 rotating at low speed p 141 N87-26176 p 151 A87-40339 THOMPSON, DANIEL F. VAUGHAN, ROBERT E. TSANG, CHIT-SANG Microcrack resistant structural composite tubes for End-to-end communications for Space Station FDMA system design and analysis for Space Station p 106 A87-41022 space applications p 85 A87-45522 p 85 A87-45483 THOMPSON, JOE J. VEDRENNE, G. TSUCHIYA, KAZUO Space Station EVA using a maneuvering enclosure The Signe II gamma-ray burst experiment aboard the Precise pointing control of flexible spacecraft p 150 A87-38443 unit p 55 A87-32446 Prognoz 9 satellite p 135 A87-38782 [SAF PAPER 861010] TSUDA. SHOICHI THOMPSON, JOSEPH J. Automatic docking maneuver and attitude control s An evaluation of options to satisfy Space Station EVA Payload boomerang technology for space experiments p 71 N87-25395 vetem p 146 A87-32540 at very low gravity level requirements VENKAYYA, V. B. [SAE PAPER 861008] p 134 A87-38780 Structural optimization with frequency constraints Antenna systems and RF coverage for the Space p 13 A87-33588 THOMPSON, R. C. [AIAA PAPER 87-0787] p 2 A87-45523 A quasi-analytical method for non-iterative computation Station Structural and control optimization of space structures p 66 N87-22731 of nonlinear controls TUELL, L. P. p 17 A87-33737 [AIAA PAPER 87-0939] THOMPSON, WILLIAM B. Equations of motion of a space station with emphasis VENNERI, SAMUEL L. Electrodynamic tether propulsion - Potential uses and on the effects of the gravity gradient Future trends in spacecraft design and qualification p 124 A87-40510 p 64 N87-21993 [NASA-TM-86588] p 2 N87-20356 THORESON, D. W. TULLIS, THOMAS S. VERDIN. D. Environmental avoidance concepts for steerable Space Surface modification to minimise the electrostatic The use of multidimensional scaling for facilities layout Station radiators An application to the design of the Space Station charging of Kapton in the space environment p 41 A87-32665 (SAE PAPER 861831) p 118 A87-33003 p 87 N87-26959 THORNTON, WILLIAM E. Analysis of crew functions as an aid in Space Station VERESHCHETIN, V. S. An improved waste collection system for space flight
[SAE PAPER 861014] p 119 A87-38784 Legal problems concerning manned space flight interior layout [SAE PAPER 860934] p 151 A87-40339 p 163 A87-38724 THORSTENSON, YVONNE R. VEROSTKO, CHARLES E. TUNINETTI. G. Quality requirements for reclaimed/recycled water Organic Rankine cycle power conversion systems for Results on reuse of reclaimed shower water p 53 N87-27392 [NASA-TM-58279] p 50 A87-38762 [SAE PAPER 860983] pace applications p 159 N87-28989 THURMOND, BEVERLY A. VETRELLA, S. TURNER, GARY F. Space Station Food System The Tethered Satellite System as a new remote sensing Test results from the solar array flight experiment p 48 A87-38720 ISAF PAPER 8609301 p 124 A87-39183 p 83 N87-29010 platform TILLMAN, BARRY VISENTINE, J. TURNER, J. D. Human factors standards for space habitation Selected materials issues associated with Space A quasi-analytical method for non-iterative computation p 162 A87-33022 p 105 A87-32061 Station p 66 N87-22731 of nonlinear controls TINKER, M. L. Review of Low Earth Orbital (LEO) flight experiments Initial investigations into the damping characteristics of TURNER, JAMES D. p 131 N87-26174 Research in slewing and tracking control wire rope vibration isolators VISENTINE, J. T. p 70 N87-24512 [NASA-CR-180698] p 28 N87-20569 The definition of the low earth orbital environment and TISHLER, V. A. TURNER, RUSSELL M. its effect on thermal control materials Evaluation of physical work capacity of cosmonauts Lanczos modes for reduced-order control of flexible p 43 A87-43103 [AIAA PAPER 87-1599] p 33 N87-22739 p 157 N87-20735 aboard Salyut-6 station structures Mass spectrometers and atomic oxygen p 141 N87-26176 Evaluation of the built-in stresses and residual distortions VISENTINE, JAMES U on cured composites for space antenna reflectors High intensity 5 eV atomic oxygen source and Low Earth p 22 A87-47327 applications Orbit (LEO) simulation facility p 141 N87-26186 TOBBE, PATRICK A. **UENO. KENJI** VISENTINE, JAMES T. Contact dynamics math model On-board K- and S-band multi-beam antennas Material interactions with the Low Earth Orbital (LEO) p 71 N87-25801 p 86 A87-46281 [NASA-CR-179147] environment: Accurate reaction rate measurements TODA, Y. p 108 N87-26175 UNTERBERG, WALTER Study of actuator for large space manipulator arm Density uncertainty effect on cost of space station VISWANATHAN, R. p 12 A87-32545 p 170 N87-20667 Modeling of environmentally induced transients within reboost A master-slave manipulator system for space use satellites p 147 A87-32546 [AIAA PAPER 85-0387] p 7 A87-41611 TODA. YOSHITSUGU VÕIGT, SUSAN J. Development of harmonic drive actuator for space A workstation environment for software engineering p 149 A87-35076 manipulator p 116 N87-29128 VAICAITIS, R. TODA, YOSHITUGU Engineering graphics and image processing at Langley Vibrations and structureborne noise in space station Development of a small-sized space manipulator p 10 N87-29129 p 39 N87-29590 Research Center [NASA-CR-181381] p 101 A87-51979 VOITKOV, N. I. VALENTINY, G. TOLIVAR, A. F. Determination of the natural frequencies of the p 136 N87-20628 Servicing of the polar platform Control technology overview in CSI longitudinal and torsional vibrations of truss structures with VALLERANI, ERNESTO p 69 N87-24507 p 152 A87-46121 attached rigid bodies p 153 A87-46945 Columbus pressurized modules TOLK, N. H. VON FLOTOW, A. H. The production of low-energy neutral oxygen beams by VAMPOLA, A. L. Some approximations for the dynamics of spacecraft p 131 N87-26191 Thick dielectric charging on high altitude spacecraft grazing-incidence neutralization p 87 N87-26961 tethers TOMITA, MASAYUKI [AIAA PAPER 87-0821] p 122 A87-33687 Structure and function of Deployable Truss Beam VAN SCHOOR, MARTHINUS C. Wave propagation in periodic truss structures
[AIAA PAPER 87-0944] p 18 A6 and metal matrix p 12 A87-32548 Material damping in aluminum p 18 A87-33742 (DTB) p 106 A87-49797 TORRE LARRY P. VON KRIES, WULF Structure-property relationships in polymer resistance VANDERVOORT, R. J. Flunking on Space Station cooperation? p 106 A87-38642 Notes on implementation of Coulomb friction in coupled p 150 A87-37964 to atomic oxygen p 67 N87-22746 Comments on the interaction of materials with atomic dynamical simulations VONPRAGENAU, GEORGE L. p 110 N87-26206 VANDUIVENBODE, JEROEN Commit your works to the Lord, and your thoughts shall oxygen Status of series-resonant power conversion with high TOTÍ, WILLIAM J. be established (Prov. 16:3). Inter-stable control systems internal frequencies. Support in definition of space station The effect of multipath on digital communications power interface systems: With application to space station VOQUE H. L. p 86 N87-22876 [ESA-CR(P)-2319] p 79 N87-24533 [AD-A178578]

VANE. DEBORAH

Polar Platform

Earth resources instrumentation for the Space Station

p 126 A87-44184

TOWNSEND, JOHN S.

Space station structures and dynamics test program
[NASA-TP-2710] p 28 N87-20568

p 134 A87-38755

VU. LOC QUOC

Dynamics of flexible structures performing large overall motions: A geometrically-nonlinear approach

p 64 N87-21335

WADA, B. K.

Validation of large space structures by ground tests p 11 A87-32336

System identification of a truss type space structure using the multiple boundary condition test (MBCT)

[AIAA PAPER 87-0746]

p 16 A87-33670

p 167 A87-40068

Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical p 8 N87-20581

Structural dynamics system model reduction

p 32 N87-22727

WADA, BEN K.

On sine dwell or broadband methods for modal testing [AIAA PAPER 87-0961] p 18 A87-33752 Structural qualification of large spacecraft

p 26 N87-20361 Verification of flexible structures by ground test

p 31 N87-22713

Ground test of large flexible structures p 34 N87-24510

WADE, D. C.

The mechanics of manufacturing in space

WAGNER, LEE

Space station power semiconductor package [NASA-CR-180829] p 81 N87-28825

WAGNER, R. Carbon fibre slotted waveguide arrays

p 85 A87-41302

WAGNER, R. C.

A Space Station utility - Static Feed Electrolyzer [SAE PAPER 860920]

p 47 A87-38712

WAGONER, R. G.

Power management equipment for space applications [SAE PAPER 861621] p 74 A87-32578

WAHBAH, M. M.

The dynamics and control of the Space Station polar piatform

[AIAA PAPER 87-2600] p.62 A87-50562

WAITES, HENRY

Large space structures testing

[NASA-TM-100306] p 35 N87-24520 Distributed control using linear momentum exchange devices

[NASA-TM-100308] WAITES, HENRY B.

p 70 N87-24521

Large space structures ground experiment checkout

p 30 N87-22704 Characterization and hardware modification of linear

momentum exchange devices [NASA-TM-86594] p 70 N87-24723

WAKAKI. T. Mission scheduling expert system and its space station applications

[AIAA PAPER 87-2221] WALKER, B. K.

p 7 A87-48602

Mass property estimation for control of asymmetrical satellites p 63 A87-52968

WALKER, BRUCE K.

On the performance analysis of a real-time distributed computer system p 111 A87-31518

WALKER, DELORES H.

Testing of materials for solar power space applications p 107 A87-53946 WALKER, P.

Application of reanalysis techniques in dynamic analysis p 21 A87-38824 of spacecraft structures WALL J. A.

Spacecraft dielectric material properties and spacecraft p 105 A87-33100

WALLGREN, KENNETH

Proceedings: Computer Science and Data Systems Technical Symposium, volume 1

[NASA-TM-89285] p 116 N87-29124 Proceedings: Computer Science and Data Systems Technical Symposium, volume 2

p 116 N87-29144

WALLSOM, RICHARD E.

Mobile remote manipulator vehicle system [NASA-CASE-LAR-13393-1] p 103 p 103 N87-29118

WALSH, DONALD E.

Present and future military uses of outer space: International law, politics, and the practice of states [AD-A1767221 p 170 N87-21753 WALSH, JOANNE L.

Optimization procedure to control the coupling of vibration modes in flexible space structures

[AIAA PAPER 87-0826] WAITER I M

Track and capture of the orbiter with the space station remote manipulator system [NASA-TM-89221] p 137 N87-25339

WANG, J. The radiation impedance of an electrodynamic tether

with end connectors p 125 A87-42585 WARD, BENJAMIN A.

Development of intelligent structures using finite control elements in a hierarchic and distributed control system [AD-A179711] p 72 N87-25805 WARD, M. T.

Integrated scheduling and resource management [AIAA PAPER 87-2213] p 119 A87-48597

WARD, ROBERT M., JR. End-to-end communications for Space Station

p 85 A87-45522

WARDEN, ROBERT M. Folding, articulated, square truss WARNAAR, DIRK B. p 40 N87-29859

Effects of local vibrations on the dynamics of space trues structures

[AIAA PAPER 87-0941] p 17 A87-33739 WARTENBERG, H.

The evolution of a serviceable EURECA

[MBB-UR-E-923/86] p 121 N87-26841

WASEL, ROBERT A. An overview of photovoltaic applications in space

p 80 N87-26414 WATANABE, S. F.

Fiber-optic monitors for space structures

p 11 A87-31505

WEBBON, BRUCE W.

An evaluation of options to satisfy Space Station EVA requirements [SAE PAPER 861008] p 134 A87-38780

WEBER, W. J., III Antenna Technology Shuttle Experiment (ATSE)

WEL J. D. Perturbation analysis of internal balancing for lightly damped mechanical systems with gyroscopic

p 87 N87-24508

circulatory forces p 22 A87-47812 WEIBEL, MARC Physiological requirements and pressure control of a

enacenlane [SAE PAPER 860965] p 150 A87-38747

WEISHAUPT, U.

Micrometeorite exposure of solar arrays

p 82 N87-28982 WELCH, RAYMOND V.

Space Infrared Telescope Facility/Multimission Modular Spacecraft Attitude Control System conceptual design p 56 A87-32736

WELCHER, BLAKE A. Gas tungsten arc welding in a microgravity environment: Work done on GAS payload G-169 p 136 N87-20306

WERSTIUK, H. L. The Radarsat Modular Opto-electronic Multispectral Scanner (R-MOMS): A potential candidate for the Polar Orbiting Platform (POP) also

[MBB-UR-873/86] p 130 N87-25506 WESSELSKI, CLARENCE J. Collect lock joint for space station truss

[NASA-CASE-MSC-21207-1] p 36 N87-25576

WESTBROOK, JACK H.

Computerized aerospace materials data: Proceedings of the Workshop on Computerized Property Materials and Design Data for the Aerospace Industry, El Segundo, CA, June 23-25, 1986 p 111 A87-35282

WEYANDT, J.

The evolution of a serviceable EURECA [MBB-UR-E-923/86] p 121 N87-26841

WHITE, K. ALAN, III

Liquid droplet radiator development status [AIAA PAPER 87-1537] p 43 p 43 A87-43059 Liquid droplet radiator development status

[NASA-TM-89852] p 44 N87-20353 WHITE, K. ALLAN, III

Liquid sheet radiator [AIAA PAPER 87-1525]

p 43 A87-43048 WHITEHEAD, K. D. Design parameters and environmental considerations

for a reusable aeroassisted orbital transfer vehicle [AIAA PAPER 87-1505] p 160 A87-43031 WHITELAW, V.

Space Station Information System integrated communications concept [AIAA PAPER 87-2228] p 114 A87-48606 Space Station Information System requirements for

integrated communications [AIAA PAPER 87-22291 p 114 A87-48607 WHITELAW, VIRGINIA A.

Space Station data management system architecture p 111 A87-37293

WHITMAN, RUTH

Servicing of user payload equipment in the Space Station ressurized environment

ISAE PAPER 8609731 WHITMORE, HENRY

An improved waste collection system for space flight

[SAE PAPER 861014] p 119 A87-38784 WHITNEY, D. E.

An integrated approach to spacecraft design for robotic servicing [AIAA PAPER 87-1672] p 100 A87-41152

WHITSETT, C. E.

Role of the manned maneuvering unit for the Space Station

SAE PAPER 8618341

p 133 A87-32667

WIDNALL, WILLIAM

Development of intelligent structures using finite control elements in a hierarchic and distributed control system [AD-A179711] p 72 N87-25805

WIE. BONG Active vibration control synthesis for the COFS-I - A classical approach

[AIAA PAPER 87-2322] p 23 A87-50443 A new concept of generalized structural filtering for active vibration control synthesis

[AIAA PAPER 87-2456] p 24 A87-50502 WIENSS, W. Possibilities of the further development of Columbus to

an autonomous European space station [MBB-UR-E-922/86] p 158 N87-25418

WÎJKER, J. J. Acoustic effects on the dynamic of lightweight

p 28 N87-20372 WILEY, LOWELL F.

Plant and animal accommodation for Space Station [SAE PAPER 860975] p 124 A87-38757

WILHELM, E. E. Space station integrated wall design and penetration damage control. Task 3: Theoretical analysis of penetration

mechanics [NASA-CR-179166] p 39 N87-28582

WILHELM, JOHN A. The undersea habitat as a space station analog: valuation of research and training potential [NASA-CR-180342] p 53 N87-27405

WÎLKINSON, C. L.

Space-based OTV boiloff disposition [AIAA PAPER 87-1767]

p 91 A87-45191 WILLIAMS, D. M.

Traction-drive, seven-degree-of-freedom telerobot arm-A concept for manipulation in space p 104 N87-29867 WILLIAMS, J. L.

Distributed parameter modeling of the structural dynamics of the Solar Array Flight Experiment [AIAA PAPER 87-2460] p 25 A87-50506

WILLIAMS, J. P. On-line identification and attitude control for SCOLE [AIAA PAPER 87-2459]

p 61 A87-50505 WILLIAMS, JAMES H., JR. Wave-mode coordinates and scattering matrices for wave propagation

[AD-A176998] p 29 N87-21030 Comparison of wave-mode coordinate and pulse summation methods

p 30 N87-21992 Wave propagation in transversely isotropic continuum models of LSS (Large Space Structures)

AD-A177271] p 30 N87-22256

WILLIAMS, JEFFREY P. Status report and preliminary results of the spacecraft

control laboratory experiment p 66 N87-22717 Controls-structures-electromagnetics interaction p 69 N87-24502 program Slew maneuvers on the SCOLE Laboratory Facility

p 69 N87-24511 WILLIAMS, TREVOR

Identification of large space structures - A factorization approach p 25 A87-52966

WILLIAMSON, W. S. Automatic charge control system for geosynchronous p 87 N87-26960

satellites WILLSHIRE, KELLI F.

Space Station end effector strategy study [NASA-TM-100488] p 103 p 103 N87-29593

WILSON, ANDREW Ion thrusters advance

p 93 A87-54196 WILSON, GERALD R. Military space station implications [AD-A180831]

WILSON, J. F.

Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728

p 172 N87-26964

WILSON, JOHN F.		A study on singularity of single gimbal CMG systems p 149 A87-35077
Synergetic plane-change capability of a co aeromaneuvering-orbital-transfer vehicle	onceptual	Modeling and control of torsional vibrations in a flexible
[AIAA PAPER 87-2565] p 92 At	87-49615	structure p 60 A87-50033
WILTBERGER, NANCY L.		YAKUT, M. M.
The growth and harvesting of algae in a micronwent p 165 No.	ro-gravity 87-20325	Space Station galley design (SAF PAPER 860932) p 119 A87-38722
environment p 165 Ni WINCHELL, J. W.	07-E00E0	[SAE PAPER 860932] p 119 A87-38722 YAM, YEUNG
Commercial US transfer vehicle overview		Flexible system model reduction and control system
[CALL TALL CALLED ]	87-32625	design based upon actuator and sensor influence
WISE, JOSEPH High power/large area PV systems		functions p 59 A87-46301
p 80 N	87-26452	YAMADA, AKIRA Water recycling system using thermopervaporation
WITTCHEN, T.	r colle	method p 46 A87-32458
Absolute indoor calibration of large area solar p 159 Ni	87-29015	YAMADA, KATSUHIKO
WOHLWEND, J. W.		Precise pointing control of flexible spacecraft p 55 A87-32446
Structural and preliminary thermal performand of a pressure activated contact heat exchanger	ce testing	Development of a small-sized space manipulator
[AIAA PAPER 87-1540] p 44 A	87-44843	p 101 A87-51979
WOLBERS, HARRY L., JR.		YAMAGATA, TASUKU
Habitation module for the Space Station	87-38718	Development of graphite epoxy space structure p 105 A87-32342
[SAE PAPER 860928] p 163 A WOLF, P.	101-001-10	YAMAGUCHI, ISAO
ESA Columbus polar platform design concept	t	Local control for large space structures
·	187-20627	p 54 A87-32440
WOLFE, M. G.  Trends in space transportation p 168 A	87-41572	A preliminary study on a linear inertial actuator for LSS control p 55 A87-32447
WOLFF. F.		YAMAGUCHI, MASANOBU
Control considerations for high frequency, r	esonant,	Development of graphite epoxy space structure
power processing equipment used in large syste [NASA-TM-89926] p 68 N	ems 187-23690	p 105 A87-32342
WOLFF, FREDRICK J.		YAMAMOTO, HARUMITSU  Japanese experiment module data management and
20 kHz Space Station power system		communication system p 147 A87-32542
•	87-40378	YAMAMOTO, MASATAKA
WOO, H. H.  Preliminary evaluation of a reaction control s	system for	Structural design and component tests of large geostationary satellite bus p 144 A87-32335
the space station p 67 N	187-22736	geostationary satellite bus p 144 A87-32335 YAMAMOTO, TETSUYA
WOO, K. T.		Development of full scale deployable CFRP truss for
GPS applications to the Space Station p 136 A	87-45525	space structure p 25 A87-51793
WOOD, GEORGE M., JR.		YAMANAKA, TATSUO On the payload-tether technology providing the
The tethered satellite system for low aerothermodynamics studies p 127 A	A87-52450	microgravity circumstances in the proximity of the Space
WOOD, L. L.		Station p 122 A87-32533
Toward the year 2000: The near future of the	American	YANG, CIANN-DONG
civilian and military space programs	187-22697	New time-domain identification technique p 58 A87-40869
[DE87-006467] p 171 N WOODS, T. G.	101-22001	YEH, FANG-BO
Advanced EVA system design requirement	nts study:	New time-domain identification technique
EVAS/space station system interface requirement [NASA-CR-171981] p 120 N	ents 187-20351	p 58 A87-40869
WOOLFORD, BARBARA J.		YEH, TSO-PING  Analytical and experimental modeling of zero/low gravity
Manned space flight p 167	A87-33019	fluid behavior
WORLEY, H. EUGENE Large space structures testing		[AIAA PAPER 87-1865] p 91 A87-45260
[NASA-TM-100306] p 35 N	N87-24520	YEREMIN, A. V.  Evaluation of physical work capacity of cosmonauts
WRIGHT, M. A.		aboard Salyut-6 station p 157 N87-20735
Space station integrated wall design and p	enetration	YERMACK, LARRY P.
damage control [NASA-CR-179165] p 39 N	N87-28581	The Space Station - Work Package 3 p 118 A87-32529
WRIGHT, ROBERT L.		•
NASA/DOD Control/Structures Interaction Te	echnology,	YEUNG, HUBERT K. Wave-mode coordinates and scattering matrices fo
1986 [NASA-CP-2447-PT-2] p 34 N	N87-24495	wave propagation
WU, S. T.		[AD-A176998] p 29 N87-21030
Contamination assessment for OSSA space s	station IOC	Comparison of wave-mode coordinate and pulse summation methods
payloads	N87-26082	[AD-A177795] p 30 N87-21993
[NASA-CR-181165] p 141 N		YONEMOTO, JAMES T.
Development of a water recovery subsystem	n based on	Space Station tracking subsystem sensor evaluation p 85 A87-4552
Vapor Phase Catalytic Ammonia Removal (VPC	CAR)	YORCHAK, JOHN P.
[SAE PAPER 860985] p 50 /	A87-38764	Planning for unanticipated satellite servicing
Reactions of atomic oxygen (O(P-3)) with polyt	butadienes	teleoperations p 118 A87-3304
and related polymers p 109	N87-26197	YOSHIDA, T.  Development of control and monitor subsystem for
WYN-ROBERTS, D. W.	NO7 20061	electric propulsion experiment onboard Space Flyer Uni
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	N87-29861	(SFU)
WYNVEEN, R. A.  Environmental control and life support techn	ologies for	[AIAÁ PAPER 87-1041] p 76 A87-3962 YOSHIHARA, MAKOTO
advanced manned space missions		The design and development of a two-dimensions
[SAE PAPER 860994] p 51	A87-38771	adaptive truss structure p 40 N87-2986
2.7		YOSHIKADO, SHIN  Observation of precipitation from space by the weather
Y		radar p 145 A87-3250
		YOSHIMOTO, SHIGETOSHI
YAE, K. H.		Communication missions for geostationary platforms

Response bounds for linear underdamped sys [ASME PAPER 87-APM-34] p 59 A87-42505

YAJIMA. NOBUYUKI

Flexibility control of torsional vibrations of a large solar rray p 12 A87-32442 array Control of flexible solar arrays with consideration of the

actuator dynamics of the reaction wheel p 55 A87-32448

latforms D 84 A87-34797

YOSHIMURA, SHOICHI

On the payload-tether technology providing the microgravity circumstances in the proximity of the Space p 122 A87-32533 Station

YOSHIMURA, YOSHINORI

Development of exposed deck of Japanese experiment nodule p 145 A87-32532 module

YOSHIOKA, T.

Mission scheduling expert system and its space station applications p 7 A87-48602 [AIAA PAPER 87-2221]

YOUNG, ARCHIE C.

Use of the Orbital Maneuvering Vehicle (OMV) for placement and retrieval of spacecraft and platforms p 133 A87-32743 [AAS PAPER 86-041] YOUNG, CHRIS

Design of a mixed fleet transportation system to low Earth orbit. Volume 1: Executive summary. Volume 2: Near-term shuttle replacement. Volume 3: Heavy-lift cargo vehicle. Volume 4: Advanced technology shuttle replacement p 5 N87-29583

YOUNG, JOHN W.

Dynamic and attitude control characteristics of an International Space Station

[AIAA PAPER 87-0931] p 57 A87-33731 Dual keel space station control/structures interaction p 67 N87-22737

YOUNG, LEIGHTON E.

Solar array flight experiment/dynamic augmentation experiment p 63 N87-20380 INASA-TP-26901

YOUNG, RICHARD C.

Proposed application of automated biomonitoring for rapid detection of toxic substances in water supplies for p 164 A87-40098 permanent space stations

A 25-LBF gaseous oxygen/gaseous hydrogen thruster p 98 N87-26132 for space station application YURKOVICH, S.

Control of multiple-mirror/flexible-structures in slew

p 24 A87-50445 [AIAA PAPER 87-2324]

Z

ZAHN, R. W.

An advanced wind scatterometer for the Columbus Polar Platform payload ZAITSEV, YURIY p 155 A87-53117

IKI department head on orbital power plants

p 158 N87-27693

ZAK, M.

Modeling of controlled flexible structures with impulsive p 33 N87-22745

ZAK, MICHAIL

Dynamical response to pulse excitations in large space

[AIAA PAPER 87-0710] p 15 A87-33658 ZANA, LYNETTE M.

Effect of nozzle geometry on the resistojet exhaust

plume [AIAA PAPER 87-2121] p 62 A87-52252

ZDANKIEWICZ, ED M. Phase change water recovery for Space Station -

Parametric testing and analysis p 51 A87-38765 [SAE PAPER 860986]

ZENTNER, RONALD C. Prototype thermal bus for manned Space Station

compartments p 41 A87-32668 (SAF PAPER 861825)

ZEWEN, HELMUT

Status and tendencies for low to medium thrust propulsion systems p 90 A87-42680 [IAF PAPER 86-162]

ZĤUKOV, G. P. Legal problems concerning manned space flight

p 151 A87-40339 ZIJDEMANS, PH. J.

The INMARSAT solar array: The first Advanced Rigid p 82 N87-28975 Array (ARA) to fly

ZIMCIK, D. G. Effect of long-term exposure to LEO space environment n spacecraft materials p 106 A87-39426 on spacecraft materials Effect of long-term exposure to Low Earth Orbit (LEO) p 142 N87-26207

ZIMM, C. B.

Magnetic refrigeration for space platforms p 118 A87-32613 [SAE PAPER 861724]

ZIMMERMAN, D. C. Vibration suppression using a constrained rate-feedback Threshold control strategy

p 6 A87-33665 [AIAA PAPER 87-0741]

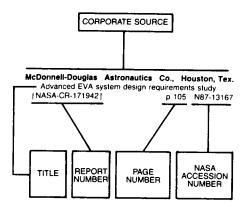
ZULIANI, L. Advanced Solar GaAs Array (ASGA) experiment on EURECA: Flight objectives and instrument configuration

ZWANENBURG, R.

The Fokker Strongback solar array p 82 N87-28979

p 83 N87-28985

#### **Typical Corporate Source Index Listing**



Listings in this index are arranged alphabetically by corporate source. The title of the document is used to provide a brief description of the subject matter. The page number and the accession number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document.

#### Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France)

Mechanical Qualification of Large Flexible Spacecraft [AD-A1755291 p 26 N87-20355

The Aerospace Environment at High Altitudes and its Implications for Spacecraft Charging Communications

[AGARD-CP-406] p 142 N87-26937

#### AEC-Able Engineering Co., Inc., Goleta, Calif.

Folding, articulated, square truss p 40 N87-29859 Space Station alpha joint bearing p 83 N87-29882

#### AEG-Telefunken, Wedel (West Germany).

An alternative module configuration for advanced solar arrays in low Earth orbits

p 159 N87-28968

improved solar generator technology for the EURECA low Earth orbit p 159 N87-28974

High power solar array technologies p 82 N87-28976

Aeritalia S.p.A., Naples (Italy).
Attitude and Orientation System (AOCS) tasks on Rendezvous and Docking (RVD) (docking-undocking phases). Architecture of the whole simulator, volume 2 [LP-RP-AI-204-VOL-2] p 68 N87-24490

Attitude and Orientation Control System (AOCS) tasks on Rendezvous and Docking (RVD) (docking-undocking phases). Simulation set-up and results, volume 3 [LP-RP-AI-204-VOL-31 p 69 N87-24491

Attitude and Orientation Control System (AOCS) tasks on Rendezvous and Docking (RVD) (docking-undocking phases). Docking-undocking phase analysis [LP-RP-Al-204-VOL-1] p 70 N87-24514

Aerojet Strategic Propulsion Co., Sacramento, Calif. Evaluation of carbon-carbon for space engine nozzle p 98 N87-26116

Aerospace Corp., El Segundo, Calif.

Potential modulations on SCATHA (Spacecraft Charging At High Altitude) spacecraft

[AD-A176815] p 140 N87-21024 Laboratory studies of atomic oxygen reactions with p 4 N87-26185

Effects on advanced materials: Results of the STS-8 EOIM (Effects of Oxygen Interaction with Materials)

[AD-A182931] p 110 N87-29709

#### Aerospace Corp., Los Angeles, Calif.

Potential modulation on the SCATHA spacecraft p 138 A87-34460

Thick dielectric charging on high altitude spacecraft N87-26961 p 87

Air Command and Staff Coll., Maxwell AFB, Ala.

Military man in space: A history of Air Force efforts to find a manned space mission p 171 N87-25815

Air Force Flight Dynamics Lab., Wright-Patterson AFB.

Development of precision structural joints for large space structures p 28 N87-20374

#### Air Force Geophysics Lab., Hanscom AFB, Mass.

Automatic charge control system for geosynchronous satellites p 87 N87-26960

Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. Present and future military uses of outer space: International law, politics, and the practice of states [AD-A1767221 p 170 N87-21753

Optimal shuttle altitude changes using tethers [AD-A179205]

p 129 N87-22756 Moving-bank multiple model adaptive estimation applied to flexible spacestructure control

[AD-A178870] Developing a voice-controlled, computer-generated display to assist space station astronauts during

maintenance activity [AD-A178997] p 120 N87-22762 A quantitative comparison of several orbital maneuvering

rehicle configurations for satellite repair/replenishment [AD-A179106] p 161 N87-23677 A systems analysis of emergency escape and recovery

systems for the US space station [AD-A179233] p 3 N87-23680

An analysis of space station motion subject to the parametric excitation of periodic elevator motion p 68 N87-23681

A multiple attribute decision analysis of manned airlock

[AD-A179241] p 137 N87-23682 The effects of structural perturbations on decoupled ontrol p 35 N87-25359

Computer modeling of high-voltage experiment using the NASCAP/LEO (NASA Charging Analyzer Program/Low Earth Orbit) computer code [AD-A1825891 p 81 N87-28186

The liquid droplet radiator in space: A parametric

FAD-A1826051 p 46 N87-29217

#### Air Force Office of Scientific Research, Bolling AFB, Washington, D.C.

Air Force basic research in dynamics and control of large space structures p 63 N87-20577 Air Force Rocket Propulsion Lab., Edwards AFB, Calif.

Identification of large space state-of-practice report p.31 N87-22705

Air Force Space Div., Los Angeles, Calif. National space transportation studies

[SAE PAPER 861681] p 160 A87-32598 Air Force Weapons Lab., Kirtland AFB, N. Mex. Joint Optics Structures Experiment (JOSE)

#### p 34 N87-24497 Air Force Wright Aeronautical Labs., Wright-Patterson AFB. Ohio.

Optimum mix of passive and active control of space p 65 N87-22714 AiResearch Mfg. Co., Torrance, Calif.

Air Evaporation closed cycle water recovery technology Advanced energy saving designs [SAE PAPER 860987] p 51 A87-38766 Akron Univ., Ohio.

Effect of nozzle geometry on the resistojet exhaust

AIAA PAPER 87-21211 Alabama Univ., Huntaville, p 62 A87-52252

Potential modulation on the SCATHA spacecraft

p 138 A87-34460

Investigation of beam-plasma interactions [NASA-CR-180579] N87-22508 p 129 Analytical determination of space station response to crew motion and design of suspension system for microgravity experiments 0 67 N87-22752

Contamination assessment for OSSA space station IOC pavioads [NASA-CR-181165] p 141 N87-26082 Interaction of hyperthermal atoms on surfaces in orbit:

The University of Alabama experiment p 108 N87-26177

Electron beam experiments at high altitudes

p 142 N87-26946

Alcatel Thomson Espace, Toulouse (France). Assessment of space station power system

(ATES-AN-86/466) p 79 N87-24530

Allegheny Observatory, Pittsburgh, Pa.

Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222 Allied Bendix Aerospace, Teterboro, N.J.

Adaptive momentum management for large space structures

[NASA-CR-179085] p 67 N87-22758

Arizona State Univ., Tempe.

A hybrid nonlinear programming method for design optimization p7 A87-35718 Arizona Univ., Tucson.

Astrometric telescope of ten microarcsecond accuracy on the Space Station p 122 A87-35222 Army Military Personnel Center, Alexandria, Va.

Thermal and dynamical effects on electrodynamic space

[AD-A180276] p 130 N87-25351 Suboptimal control of large flexible space structures

experiencing rotational dynamics nonlinearities [AD-A1806061 p 71 N87-25352

Army War Coll., Carlisie Barracks, Pa. Military space station implications

[AD-A180831] p 172 N87-26964 Astro Aerospace Corp., Carpinteria, Calif.

Structural concepts for large solar concentrators [NASA-CR-4075] p 65 N87-21994

Design, development and fabrication of a deployable/retractable truss beam model for large space structures application [NASA-CR-178287] p 35 N87-25349

Atomic Energy Research Establishment, Harwell (England).

Surface modification to minimise the electrostatic charging of Kapton in the space environment

p 87 N87-26959

#### Auburn Univ., Ala.

Analytical solutions for static elastic deformations of wire [AIAA PAPER 87-0720]

p 6 A87-33561 Initial investigations into the damping characteristics of wire rope vibration isolators

[NASA-CR-1806981 p 28 N87-20569 Space Station/Shuttle Orbiter dynamics during p 65 N87-22708 docking

Improving stability margins in discrete-time LQG controllers p 31 N87-22719

A new approach for vibration control in large space tructures p 33 N87-22743 structures

#### В

Babcock and Wilcox Co., Lynchburg, Va.

Nuclear propulsion systems for orbit transfer based on the particle bed reactor [DE87-0100601 p 99 N87-28405

Ball Aerospace Systems Div., Boulder, Colo.

Rendezvous and docking tracker

[AAS PAPER 86-014] p 133 A87-32733

p 83 N87-28985

p 50 A87-38764

p 141 N87-26183

p 115 N87-26698

Urban

Centro Informazioni Studi Esperienze, Milan (Italy). Advanced Solar GaAs Array (ASGA) experiment on EURECA: Flight objectives and instrument configuration

Phase 3 study of selected tether applications in space.	A formulation for studying steady state/transient
Volume 1: Executive summary [NASA-CR-179185] p 131 N87-29585	dynamics of a large class of spacecraft and its
attelle Pacific Northwest Labs., Richland, Wash.	application p 35 N87-25357
Two-phase reduced gravity experiments for a space	Brookhaven National Lab., Upton, N. Y.
reactor design p 8 N87-21154	Nuclear propulsion systems for orbit transfer based on the particle bed reactor
eech Aircraft Corp., Boulder, Colo.	[DE87-010060] p 99 N87-28405
Space station experiment definition: Long term cryogenic fluid storage p 94 N87-21144	Brunel Univ., Uxbridge (England).
nala ciolage	Preliminary study of a Biological and Biochemical
Space station experiment	Analysis Facility (BBAF) for Columbus: Executive
cryogenic fluid storage [NASA-CR-4072] p 97 N87-24641	summary (FSA-CR(P)-2338) p 158 N87-27698
elgian Royal Observatory, Brussels.	[ESA-CR(P)-2338] p 158 N87-27698
Solid Earth panel report p 157 N87-20636	C
ell Telephone Labs., Inc., Murray Hill, N. J.	C
A crisis in the NASA space and earth sciences	California inst. of Tech., Pasadena.
programme p 112 A87-37968	Identification of the zero-g shape of a space beam
lend Research, Inc., Oreg.  A membrane-based subsystem for very high recoveries	[AIAA PAPER 87-0872] p 15 A87-33636
of spacecraft waste waters	Positive position feedback control for large space
[SAE PAPER 860984] p 50 A87-38763	structures [AIAA PAPER 87-0902] p 17 A87-33711
lendix Corp., Teterboro, N.J.	[AIAA PAPER 87-0902] p 17 A87-33711 Vibration suppression by stiffness control
Adaptive momentum management for the dual keel	p 66 N87-22730
Space Station [AIAA PAPER 87-2596] p 62 A87-50558	An experimental investigation of vibration suppression
() marring and a series	in large space structures using positive position
Bionetics Corp., Hampton, Va.  An advanced technology space station for the year 2025,	feedback p 39 N87-28937
study and concepts	California State Univ., Northridge.  Soviet space stations as analogs, second edition
[NASA-CR-178208] p 120 N87-20340	[NASA-CR-180920] p 157 N87-21996
Boeing Aerospace Co., Houston, Tex.	California Univ., Berkeley.
Results on reuse of reclaimed shower water	Radiation environments and absorbed dose estimations
[SAE PAPER 860983] p 50 A87-38762	on manned space missions p 139 A87-49026
Boeing Aerospace Co., Kent, Wash. Mixing-induced fluid destratification and ullage	Dynamics of flexible structures performing large overall motions: A geometrically-nonlinear approach
Mixing-induced fluid destratification and ullage condensation p 95 N87-21149	p 64 N87-21335
Space station propulsion-ECLSS interaction study	An integrated, optimization-based approach to the
[NASA-CR-175093] p 54 N87-29594	design and control of large space structures
Boeing Aerospace Co., Seattle, Wash.	[AD-A179459] p 34 N87-23683
National space transportation studies	California Univ., Los Angeles. Integrated control/structure design and robustness
[SAE PAPER 861681] p 160 A87-32598	[SAE PAPER 861821] p 6 A87-32657
Prototype thermal bus for manned Space Station	Control augmented structural synthesis with transient
compartments (SAF PAPER 861825) p 41 A87-32668	response constraints
[SAE PAPER 861825] p 41 A87-32668  Nonlinear transient analysis of joint dominated	[AIAA PAPER 87-0749] p 56 A87-33573
structures	Perturbation analysis of internal balancing for lightly
[AIAA PAPER 87-0892] p 17 A87-33709	damped mechanical systems with gyroscopic and circulatory forces p 22 A87-47812
Science and payload options for animal and plant	Integrated control/structure design and robustness
research accommodations aboard the early Space	p 65 N87-22060
Station (SAF PAPER 860953) p 164 A87-38740	California Univ., Santa Barbara.
	Remote Sensing Information Sciences Research Group:
Plant and animal accommodation for Space Station Laboratory	Santa Barbara Information Sciences Research Group, year
[SAE PAPER 860975] p 124 A87-38757	[NASA-CR-181073] p 115 N87-24817
Development of a prototype two-phase thermal bus	Carnegle inst. of Tech., Pittsburgh, Pa.
system for Space Station	Response of joint dominated space structures
[AIAA PAPER 87-1628] p 44 A87-43126	[NASA-CR-181202] p 37 N87-26397
Space-based OTV boiloff disposition	Carnegle-Mellon Univ., Pittsburgh, Pa.
[AIAA PAPER 87-1767] p 91 A87-45191	Response of joint dominated space structures [NASA-CR-180564] p 36 N87-26071
Overview: Fluid acquisition and transfer p 94 N87-21146	Case Western Reserve Univ., Cleveland, Ohio.
	Oxygen interaction with space-power materials
Flexible spacecraft simulator p 31 N87-22/18 Precision pointing and control of flexible spacecraft	[NASA-CR-181396] p 132 N87-29633
p 66 N87-22723	Catholic Univ. of America, Washington, D.C.
Dynamics of trusses having nonlinear joints	Actuators for actively controlled space structures p 59 A87-42816
p 32 N87-22724	Control of robot manipulator compliance
Equivalent beam modeling using numerical reduction	p 100 A87-45797
techniques p 32 N87-22725	Modified independent modal space control method for
High speed simulation of flexible multibody dynamics p 33 N87-22738	active control of flexible systems
Experimental characterization of deployable trusses and	[NASA-CR-181065] p 34 N87-23980
ioints p 33 N87-22749	A comparison between IMSC, PI and MIMSC methods
Comments on the interaction of materials with atomic	in controlling the vibration of flexible systems [NASA-CR-181156] p 36 N87-25605
oxygen p 110 N87-26206	[NASA-CR-181156] p 36 N87-25605 Effect of bonding on the performance of a
Space station integrated wall design and penetration	piezoactuator-based active control system
damage control [NASA-CR-179165] p 39 N87-28581	[NASA-CR-181414] p 74 N87-29713
Space station integrated wall design and penetration	Optimum shape control of flexible beams by
damage control. Task 3: Theoretical analysis of penetration	piezo-electric actuators
mechanics	[NASA-CR-181413] p 40 N87-29898
[NASA-CR-179166] p 39 N87-28582 Space station integrated wall design and penetration	Centre d'Etudes et de Recherches, Toulouse (France).
Space station integrated wall design and penetration damage control. Task 4: Impact detection/location	On the possibility of a several-kilovolt differential charge in the day sector of a geosynchronous orbit
system	p 158 N87-26953
(NASA-CR-179167) p 4 N87-28583	MARECS and ECS anomalies: Attempt at insulation
Booz-Allen and Hamilton, Inc., Washington, D. C.	defect production in Kapton p 82 N87-28980
The impact of integrated water management on the Space Station propulsion system	Centre National d'Etudes Spatiales, Toulouse (France).
(AIAA PAPER 87-1864) p 91 A87-45259	Low frequency vibration testing on satellites

Chamberlain Mfg. Corp., Waterloo, Iowa. Development of a water recovery subsystem based on Vapor Phase Catalytic Ammonia Removal (VPCAR) [SAE PAPER 860985] Chicago Univ., Ill. Dynamics of atom-surface interactions City Univ. of New York, Bronx. Development of a computer program to generate typical measurement values for various systems on a space 1988

p 27 N87-20364

p 156 N87-20626

p 81 N87-28972

Remote sensing applications: Commercial issues and

opportunities for space station

The high performance solar array GSR3

Colorado Univ., Boulder. Evaluation of constraint stabilization procedures for multibody dynamical systems [AIAA PAPER 87-0927] p 7 A87-33728 Inadequacy of single-impulse transfers for path onstrained rendezvous p 90 A87-41615 constrained rendezvous Space Station gas-grain simulation facility - Application p 127 A87-53002 to exobiology The growth and harvesting of algae in a micro-gravity p 165 N87-20325 environment Simulation of on-orbit satellite fragmentations p 140 N87-24515 A method of variable spacing for controlled plant growth systems in spaceflight and terrestrial agriculture applications p 130 N87-25767 [NASA-CR-177447] Columbia Univ., New York, N.Y. Vibrations and structureborne noise in space station p 39 N87-29590 [NASA-CR-181381] Committee on Appropriations (U.S. House). Housing and of Department Development-independent agencies appropriations for p 171 N87-22560 [GPO-73-418] Committee on Appropriations (U.S. Senate). National Aeronautics and Space Administration p 172 N87-30220 Committee on Commerce, Science, and Transportation (U.S. Senate). National Aeronautics and Space Administration Authorization Act p 171 N87-24240 [S-REPT-100-87] NASA authorization: Authorization of appropriations for the National Aeronautics and Space Administration for fiscal year 1988 [GPO-73-245] p 172 N87-30221 Committee on Science, Space and Technology (U.S. House). National Aeronautics and Space Administration Authorization Act, fiscal year 1988 p 171 N87-25024 [H-REPT-100-204] Communications Research Centre, Ottawa (Ontario). Effect of long-term exposure to Low Earth Orbit (LEO) p 142 N87-26207 space environment Consiglio Nazionale delle Ricerche, Rome (Italy). Tethers in space; Proceedings of the International Conference, Arlington, VA, Sept. 17-19, 1986 p 123 A87-38567 p 157 N87-25031 The Columbus program Control Dynamics Co., Huntsville, Ala. One Controller at a Time (1-CAT): A mimo design p 65 N87-22715 methodology Contact dynamics math model p 71 N87-25801 [NASA-CR-179147] Cornell Univ., Ithaca, N.Y A crisis in the NASA space and earth sciences p 112 A87-37968 programme Department of the Air Force, Washington, D.C. Propellant tank resupply system p 93 N87-20375 [AD-D012559] Deutsche Forschungs- und Versuchsanstalt fuer Luftund Raumfahrt, Goettingen (West Germany). Dynamic qualification of spacecraft by means of modal p 26 N87-20363 synthesis Modal-survey testing for system identification and dynamic qualification of spacecraft structures p 27 N87-20365 Deutsche Forschungs- und Versuchsanstalt fuer Luftund Raumfahrt, Oberpfaffenhofen (West Germany).

European utilization aspects studies

[ESA-CR(P)-2361-VOL-1]

Land panel report p 128 N87-20634
Study on investigation of the attitude control of large
flexible spacecraft. Phase 1, volume 1: Technical report

p 156 N87-20624

p 73 N87-27706

(England).

[AIAA PAPER 87-1864]

British Aerospace Public Ltd. Co., Stevenage

survey testing of large space structures

Influence co-efficient testing as a substitute for modal

p 27 N87-20369

Euro

Euro

Fairc

Fraur

Galve

Garre

1 DE

[GA

Gene

Gene

ana

[NA

on-c [AIA

Si of a Lo С

components representative of space vehicles: Start basket liquid acquisition device performance analysis [NASA-CR-179138] p 97

Integrated waste and water management system

General Electric Co., Houston, Tex.

(SAE PAPER 8609961

p 97 N87-26081

p 51 A87-38773

Gener [SA E

Gene

Ford

Study on investigation of the		FAA
flexible spacecraft. Phase 2.	attitude control of la volume 1: Execu	
summary	Voidillo 1. EXOCU	1140
[ESA-CR(P)-2361-VOL-1]	p 73 N87-27	
Study on the investigation of the flexible spacecraft. Phase 2, volu	e attitude control of la	rge
[ESA-CR(P)-2361-VOL-2]	p 73 N87-27	
Study on investigation of the	attitude control of la	rge
flexible spacecraft, phase 3 [ESA-CR(P)-2361-VOL-4]	p 73 N87-277	700
Dornier-Werke G.m.b.H., Friedrich		/09
Germany).	,	
Investigation for damping desig		ear
vibrations of spacecraft structures [EMSB-64/85]	s р 35 N87-245	516
Preliminary study of a Biolog	ical and Biochemi	
Analysis Facility (BBAF) for	Columbus: Execut	tive
summary [ESA-CR(P)-2338]	p 158 N87-276	202
The extendable and retractable		
for rigid solar arrays	p 39 N87-290	
Draper (Charles Stark) Lab., Inc.,	Cambridge, Mass.	
Aeroassist flight experiment gu control	Jidance, navigation a	ına
[AAS PAPER 86-042]	p 133 A87-327	44
Shuttle orbit flight control design		for
Space Station	p 58 A87-372	95
Draper (Charles Stark) Lab., Inc., Proposed CMG momentum ma		for
space station	anagement scheme	IOI
[AIAA PAPER 87-2528]	p 62 A87-505	31
DYNACS Engineering Co., Inc., Ci		
Notes on implementation of Cou dynamical simulations	p 67 N87-227	
dynamical dinidiations	p 07 1407-227	40
E		
<b>-</b>		
Edighoffer, Inc., Newport News, V	ía.	
Quasi-static shape adjustment		ter
space antenna		
[AIAA PAPER 87-0869]	p 15 A87-336	
Dynamic analysis and experimer space station model	n metriods for a gene p 22 A87-416	
Dynamic and thermal response		
of multi-body space structural con		
[NASA-CR-178289]	p 10 N87-247	09
Electronique Serge Dassault, St. C Study of expert system applica	Cloud (France).	ote.
Study of expert system application [NE-51-867]	Cloud (France). tions to space project p 115 N87-260	
Study of expert system applica [NE-51-867] Eloret Corp., Sunnyvale, Calif.	tions to space project p 115 N87-260	57
Study of expert system applica [NE-51-867] Eloret Corp., Sunnyvale, Calif. Synergetic plane-change cap.	tions to space project p 115 N87-260 ability of a conceptu	57
Study of expert system applica [NE-51-867] Eloret Corp., Sunnyvale, Calif. Synergetic plane-change cap aeromaneuvering-orbital-transfer v	tions to space project p 115 N87-260 ability of a concepturehicle	57 Jai
Study of expert system applica [NE-51-867] Eloret Corp., Sunnyvale, Calif. Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]	tions to space project p 115 N87-260 ability of a conceptu	57 Jai
Study of expert system applica [NE-51-867]  Eloret Corp., Sunnyvale, Calif. Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]  Engineering, Inc., Hampton, Va. The results of a limited study	tions to space project p 115 N87-260 ability of a concepturehicle p 92 A87-496 of approaches to the	57 Jal 15 he
Study of expert system applica [NE-51-867] Eloret Corp., Sunnyvale, Callf. Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565] Engineering, Inc., Hampton, Va. The results of a limited study design, fabrication, and testing of a	tions to space project p 115 N87-260 ability of a concepture hicle p 92 A87-496 of approaches to the dynamic model of the position of the position of the project p 115 N87-260 ability of a concepture position of the project p 115 N87-260 ability of a concepture position of the project position	57 Jal 15 he
Study of expert system applica [NE-51-867]  Eloret Corp., Sunnyvale, Calif. Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]  Engineering, Inc., Hampton, Va. The results of a limited study	tions to space project p 115 N87-260 ability of a conceptuehicle p 92 A87-496 of approaches to the dynamic model of the summary	57 Jal 15 he
Study of expert system applica [NE-51-867]  Eloret Corp., Sunnyvale, Calif. Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]  Engineering, Inc., Hampton, Va. The results of a limited study design, fabrication, and testing of a NASA IOC space station. Executiv [NASA-CR-178276]	tions to space project p 115 N87-260 ability of a concepturehicle p 92 A87-496 of approaches to the adynamic model of the summarry p 8 N87-2102	57 Jal 15 he
Study of expert system applica [NE-51-867]. Eloret Corp., Sunnyvale, Calif. Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565] Engineering, Inc., Hampton, Va. The results of a limited study design, fabrication, and testing of a NASA IOC space station. Executiv [NASA-CR-178276] Engineering Mechanics Associatio Calif.	tions to space project p 115 N87-260 ability of a concepturehicle p 92 A87-496 of approaches to the dynamic model of the summary p 8 N87-210; on, Inc., Torrance,	57 ual 15 he he
Study of expert system applica [NE-51-867] Eloret Corp., Sunnyvale, Calif. Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565] Engineering, Inc., Hampton, Va. The results of a limited study design, fabrication, and testing of a NASA IOC space station. Executiv [NASA-CR-178276] Engineering Mechanics Associatio	tions to space project p 115 N87-260 ability of a concepturehicle p 92 A87-496 of approaches to the adviamic model of the summary p 8 N87-210; on, Inc., Torrance, verification of dynamical and the space of the spa	57  Jal  15  he  he  20
Study of expert system applica [NE-51-867]  Eloret Corp., Sunnyvale, Calif. Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]  Engineering, Inc., Hampton, Va. The results of a limited study design, fabrication, and testing of a NASA IOC space station. Executiv [NASA-CR-178276]  Engineering Mechanics Associatio Calif. A computer program for model systems	tions to space project p 115 N87-260 ability of a concepturehicle p 92 A87-496 of approaches to the dynamic model of the summary p 8 N87-210; on, Inc., Torrance,	57  Jal  15  he  he  20
Study of expert system applica [NE-51-867]. Eloret Corp., Sunnyvale, Calif. Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565] Engineering, Inc., Hampton, Va. The results of a limited study design, fabrication, and testing of a NASA IOC space station. Executiv [NASA-CR-178276] Engineering Mechanics Associatio Calif.	tions to space project p 115 N87-260 ability of a concepturehicle p 92 A87-496 of approaches to the advancing model of the summary p 8 N87-210; on, Inc., Torrance, verification of dynam p 31 N87-227; who of insulators	57  Jal  15  he  he  20
Study of expert system applica [NE-51-867]  Eloret Corp., Sunnyvale, Calif. Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]  Engineering, Inc., Hampton, Va. The results of a limited study design, fabrication, and testing of a NASA IOC space station. Executiv [NASA-CR-178276]  Engineering Mechanics Associatio Calif. A computer program for model systems  ERA Ltd., Leatherhead (England). Radiation charging and breakdor	tions to space project p 115 N87-260 ability of a concepturehicle p 92 A87-496 of approaches to the adynamic model of the summarry p 8 N87-210; on, Inc., Torrance, verification of dynamic p 31 N87-227; who of insulators p 143 N87-2694	57 ual 15 he he 20 nic
Study of expert system applica [NE-51-867]  Eloret Corp., Sunnyvale, Calif. Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]  Engineering, Inc., Hampton, Va. The results of a limited study design, fabrication, and testing of a NASA IOC space station. Executiv [NASA-CR-178276]  Engineering Mechanics Associatio Calif. A computer program for model systems  ERA Ltd., Leatherhead (England). Radiation charging and breakdor  Erno Raumfahrttechnik G.m.b.H., E	tions to space project p 115 N87-260 ability of a concepturehicle p 92 A87-496 of approaches to the adynamic model of the summarry p 8 N87-210; on, Inc., Torrance, verification of dynamic p 31 N87-227; who of insulators p 143 N87-2694	57 ual 15 he he 20 nic
Study of expert system applica [NE-51-867]  Eloret Corp., Sunnyvale, Calif.  Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]  Engineering, Inc., Hampton, Va.  The results of a limited study design, fabrication, and testing of a NASA IOC space station. Executiv [NASA-CR-178276]  Engineering Mechanics Associatio Calif.  A computer program for model systems  ERA Ltd., Leatherhead (England).  Radiation charging and breakdo	tions to space project p 115 N87-260 ability of a concepturehicle p 92 A87-496 of approaches to the summary p 8 N87-210; on, Inc., Torrance, verification of dynam p 31 N87-227; who of insulators p 143 N87-2695 Gremen (West	57 ual 15 he he 20 nic
Study of expert system applica [NE-51-867]  Eloret Corp., Sunnyvale, Calif. Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]  Engineering, Inc., Hampton, Va. The results of a limited study design, fabrication, and testing of a NASA IOC space station. Executiv [NASA-CR-178276]  Engineering Mechanics Associatio Calif. A computer program for model systems  ERA Ltd., Leatherhead (England). Radiation charging and breakdo:  Erno Raumfahrttechnik G.m.b.H., E Germany). A study of fluid transfer manage [FTMS-RPT-006]	tions to space project p 115 N87-260 ability of a concepturehicle p 92 A87-496 of approaches to the adynamic model of the summary p 8 N87-2100 on, Inc., Torrance, verification of dynamic p 31 N87-227 who of insulators p 143 N87-2698 Gremen (West ment in space p 97 N87-2605	57  ual  15  he  he  20  nic  10  54
Study of expert system applica [NE-51-867]  Eloret Corp., Sunnyvale, Calif.  Synergetic plane-change cap. aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]  Engineering, Inc., Hampton, Va. The results of a limited study design, fabrication, and testing of a NASA IOC space station. Executiv [NASA-CR-178276]  Engineering Mechanics Associatio Calif.  A computer program for model systems  ERA Ltd., Leatherhead (England). Radiation charging and breakdor  Erno Raumfahrttechnik G.m.b.H., E Germany).  A study of fluid transfer manage [FTMS-RPT-006]  Development of experimental/a	tions to space project p 115 N87-260 ability of a concepturehicle p 92 A87-496 of approaches to the adynamic model of the summary p 8 N87-2100 on, Inc., Torrance, verification of dynamic p 31 N87-227 who of insulators p 143 N87-2698 Gremen (West ment in space p 97 N87-2605	57  ual  15  he  he  20  nic  10  54
Study of expert system applica [NE-51-867]  Eloret Corp., Sunnyvale, Calif.  Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]  Engineering, Inc., Hampton, Va.  The results of a limited study design, fabrication, and testing of a NASA IOC space station. Executiv [NASA-CR-178276]  Engineering Mechanics Associatio Calif.  A computer program for model systems  ERA Ltd., Leatherhead (England). Radiation charging and breakdor  Erno Raumfahrttechnik G.m.b.H., E Germany).  A study of fluid transfer manage [FTMS-RPT-006]  Development of experimental/a structural design verification	tions to space project p 115 N87-260 ability of a concepturehicle p 92 A87-496 of approaches to the advancie model of the summary p 8 N87-210; an, Inc., Torrance, verification of dynam p 31 N87-227; who of insulators p 143 N87-269; Bremen (West ment in space p 97 N87-260; analytical concepts for the space p 145 N87-260; analytica	57  Jal  15  he  20  nic  10  54
Study of expert system applica [NE-51-867]  Eloret Corp., Sunnyvale, Calif. Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]  Engineering, Inc., Hampton, Va. The results of a limited study design, fabrication, and testing of a NASA IOC space station. Executiv [NASA-CR-178276]  Engineering Mechanics Associatio Calif. A computer program for model systems  ERA Ltd., Leatherhead (England). Radiation charging and breakdor  Erno Raumfahrttechnik G.m.b.H., E Germany). A study of fluid transfer manage [FTMS-RPT-006] Development of experimental/a structural design verification [ESA-CR(P)-2340]	ability of a conceptuehicle p 92 A87-496 of approaches to the adynamic model of the summary p 8 N87-2100 on, Inc., Torrance, verification of dynamic p 31 N87-227 who of insulators p 143 N87-2696 Bremen (West ment in space p 97 N87-2606 analytical concepts for	57  Jal  15  he  20  nic  10  54
Study of expert system applica [NE-51-867]  Eloret Corp., Sunnyvale, Calif.  Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]  Engineering, Inc., Hampton, Va.  The results of a limited study design, fabrication, and testing of a NASA IOC space station. Executiv [NASA-CR-178276]  Engineering Mechanics Association Calif.  A computer program for model systems  ERA Ltd., Leatherhead (England).  Radiation charging and breakdor  Erno Raumfahrttechnik G.m.b.H., E Germany).  A study of fluid transfer manage [FTMS-RPT-006]  Development of experimental/a structural design verification [ESA-CR(P)-2340]  European Space Agency, Paris (Fr. Proceedings of the European S	ability of a conceptuehicle p 92 A87-496 of approaches to the advantage of approaches to the summary p 8 N87-210; on, Inc., Torrance, verification of dynam p 31 N87-227; who of insulators p 143 N87-2699; strement in space p 97 N87-2699; analytical concepts for p 36 N87-2607; ance).	57  15  16  16  17  17  18  18  18  18  18  18  18  18
Study of expert system applica [NE-51-867]  Eloret Corp., Sunnyvale, Calif.  Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]  Engineering, Inc., Hampton, Va.  The results of a limited study design, fabrication, and testing of a NASA IOC space station. Executiv [NASA-CR-178276]  Engineering Mechanics Association and Calif.  A computer program for model systems  ERA Ltd., Leatherhead (England). Radiation charging and breakdor  Erno Raumfahrttechnik G.m.b.H., E Germany).  A study of fluid transfer manage [FTMS-RPT-006]  Development of experimental/a structural design verification [ESA-CR(P)-2340]  European Space Agency, Paris (Fr. Proceedings of the European Splatform Opportunities and	tions to space project p 115 N87-260 ability of a concepturehicle p 92 A87-496 of approaches to the advinamic model of the summary p 8 N87-210; on, Inc., Torrance, verification of dynam p 31 N87-227: who of insulators p 143 N87-2699 Bremen (West ment in space p 97 N87-2609 analytical concepts for p 36 N87-2607 ance). Symposium on Polis	57  15  16  16  17  17  18  18  18  18  18  18  18  18
Study of expert system applica [NE-51-867]  Eloret Corp., Sunnyvale, Calif.  Synergetic plane-change cap. aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]  Engineering, Inc., Hampton, Va. The results of a limited study design, fabrication, and testing of e NASA IOC space station. Executiv [NASA-CR-178276]  Engineering Mechanics Association Calif.  A computer program for model systems  ERA Ltd., Leatherhead (England). Radiation charging and breakdor  Erno Raumfahrttechnik G.m.b.H., E Germany).  A study of fluid transfer manage [ETMS-RPT-006]  Development of experimental/a structural design verification [ESA-CR(P)-2340]  European Space Agency, Paria (Fr. Proceedings of the European Splatform Opportunities and Remote-Sensing (ESSPOIR)	tions to space project p 115 N87-260 ability of a conceptuehicle p 92 A87-496 of approaches to the day of the summary p 8 N87-210; on, Inc., Torrance, verification of dynam p 31 N87-269; on the summary p 143 N87-260;	57 ual 15 he 20 nic 10 54 68 or 75 ar or
Study of expert system applica [NE-51-867]  Eloret Corp., Sunnyvale, Calif.  Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]  Engineering, Inc., Hampton, Va.  The results of a limited study design, fabrication, and testing of a NASA IOC space station. Executiv [NASA-CR-178276]  Engineering Mechanics Association Calif.  A computer program for model systems  ERA Ltd., Leatherhead (England).  Radiation charging and breakdor  Erno Raumfahrttechnik G.m.b.H., E Germany).  A study of fluid transfer manage [FTMS-RPT-006]  Development of experimental/a structural design verification [ESA-CR(P)-2340]  European Space Agency, Parts (Fr. Proceedings of the European Splatform Opportunities and Remote-Sensing (ESPOIR) [ESA-SP-266]	tions to space project p 115 N87-260 ability of a concepturehicle p 92 A87-496 of approaches to the advinement p 8 N87-210; on, Inc., Torrance, verification of dynam p 31 N87-227: who of insulators p 143 N87-2695 are ment in space p 97 N87-2605 analytical concepts for p 36 N87-2607 ance).  Symposium on Pola Instrumentation for p 128 N87-2605 p 128 N	57 ual 15 he 20 nic 10 54 68 or 75 ar or
Study of expert system applica [NE-51-867]  Eloret Corp., Sunnyvale, Calif.  Synergetic plane-change cap. aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]  Engineering, Inc., Hampton, Va. The results of a limited study design, fabrication, and testing of e NASA IOC space station. Executiv [NASA-CR-178276]  Engineering Mechanics Association Calif.  A computer program for model systems  ERA Ltd., Leatherhead (England). Radiation charging and breakdor  Erno Raumfahrttechnik G.m.b.H., E Germany).  A study of fluid transfer manage [ETMS-RPT-006]  Development of experimental/a structural design verification [ESA-CR(P)-2340]  European Space Agency, Paria (Fr. Proceedings of the European Splatform Opportunities and Remote-Sensing (ESSPOIR)	tions to space project p 115 N87-260 ability of a concepturehicle p 92 A87-496 of approaches to the advinement p 8 N87-210; on, Inc., Torrance, verification of dynam p 31 N87-227: who of insulators p 143 N87-2695 are ment in space p 97 N87-2605 analytical concepts for p 36 N87-2607 ance).  Symposium on Pola Instrumentation for p 128 N87-2605 p 128 N	57  ual  15  he  he  20  nic  10  54  58  or  75  ar  or
Study of expert system applica [NE-51-867]  Eloret Corp., Sunnyvale, Calif.  Synergetic plane-change capaeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]  Engineering, Inc., Hampton, Va.  The results of a limited study design, fabrication, and testing of a NASA IOC space station. Executiv [NASA-CR-178276]  Engineering Mechanics Association Calif.  A computer program for model systems  ERA Ltd., Leatherhead (England).  Radiation charging and breakdor  Erno Raumfahrttechnik G.m.b.H., E Germany).  A study of fluid transfer manage [FTMS-RPT-006]  Development of experimental/a structural design verification [ESA-CR(P)-2340]  European Space Agency, Paris (Fr. Proceedings of the European Spatform Opportunities and Remote-Sensing (ESPOIR) [ESA-SP-266]  The Columbus program: An over Servicing of the polar platform	tions to space project p 115 N87-260 ability of a conceptuehicle p 92 A87-496 of approaches to the advancing p 8 N87-210; on, Inc., Torrance, verification of dyname p 31 N87-227: who of insulators p 143 N87-269; or 143 N87-269; or 143 N87-269; or 143 N87-269; or 143 N87-260; or 143 N87-262; or 144 N87-262; or 145 N87	57  ual  15  he  he  20  nic  10  54  58  or  75  ar  or  21
Study of expert system applica [NE-51-867]  Eloret Corp., Sunnyvale, Calif.  Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]  Engineering, Inc., Hampton, Va.  The results of a limited study design, fabrication, and testing of a NASA IOC space station. Executiv [NASA-CR-178276]  Engineering Mechanics Association Calif.  A computer program for model systems  ERA Ltd., Leatherhead (England).  Radiation charging and breakdor  Erno Raumfahrttechnik G.m.b.H., E Germany).  A study of fluid transfer manage [FTMS-RPT-006]  Development of experimental/a structural design verification [ESA-CR(P)-2340]  European Space Agency, Parts (Fr. Proceedings of the European Splatform Opportunities and Remote-Sensing (ESPOIR) [ESA-SP-266]  The Columbus program: An over Servicing of the polar platform USA-Europe coordination and	tions to space project p 115 N87-260 ability of a concepturehicle p 92 A87-496 of approaches to the advinement p 8 N87-210; on, Inc., Torrance, verification of dynam p 31 N87-227: who of insulators p 143 N87-2695 are ment in space p 97 N87-2605 analytical concepts for p 128 N87-2062 analyti	57  ual  15  he  he  20  nic  15  ar  75  ar  21  23  28  38  3:
Study of expert system applica [NE-51-867]  Eloret Corp., Sunnyvale, Calif.  Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]  Engineering, Inc., Hampton, Va.  The results of a limited study design, fabrication, and testing of a NASA IOC space station. Executiv [NASA-CR-178276]  Engineering Mechanics Association Calif.  A computer program for model systems  ERA Ltd., Leatherhead (England).  Radiation charging and breakdor  Erno Raumfahrttechnik G.m.b.H., E Germany).  A study of fluid transfer manage [FTMS-RPT-006]  Development of experimental/a structural design verification [ESA-CR(P)-2340]  European Space Agency, Paris (Fr. Proceedings of the European Splatform Opportunities and Remote-Sensing (ESPOIR) [ESA-SP-266]  The Columbus program: An over Servicing of the polar platform  USA-Europe coordination and Announcements of Opportunity	tions to space project p 115 N87-260 ability of a concepturehicle p 92 A87-496 of approaches to ta adynamic model of the summary p 8 N87-210; m, Inc., Torrance, verification of dynam p 31 N87-227; who of insulators p 143 N87-269; gremen (West ment in space p 97 N87-260; analytical concepts for p 36 N87-260; analytical concepts for p 128 N87-2062; symposium on Polal Instrumentation for p 128 N87-2062; view p 156 N87-2062; view p 156 N87-2062; coperation on activities p 170 N87-2062; coperation of activities p 170 N87-2062; coperation on activities p 170 N87-2062; coperation of activities p 170 N87-2062; c	57  Jal  15  hee  20  Jac  10  10  10  10  10  10  10  10  10  1
Study of expert system applica [NE-51-867]  Eloret Corp., Sunnyvale, Calif.  Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]  Engineering, Inc., Hampton, Va.  The results of a limited study design, fabrication, and testing of a NASA IOC space station. Executiv [NASA-CR-178276]  Engineering Mechanics Association Calif.  A computer program for model systems  ERA Ltd., Leatherhead (England).  Radiation charging and breakdor  Erno Raumfahrttechnik G.m.b.H., E Germany).  A study of fluid transfer manage [FTMS-RPT-006]  Development of experimental/a structural design verification [ESA-CR(P)-2340]  European Space Agency, Parts (Fr. Proceedings of the European Splatform Opportunities and Remote-Sensing (ESPOIR) [ESA-SP-266]  The Columbus program: An over Servicing of the polar platform USA-Europe coordination and	tions to space project p 115 N87-260 ability of a concepturehicle p 92 A87-496 of approaches to ta adynamic model of the summary p 8 N87-210; m, Inc., Torrance, verification of dynam p 31 N87-227; who of insulators p 143 N87-269; gremen (West ment in space p 97 N87-260; analytical concepts for p 36 N87-260; analytical concepts for p 128 N87-2062; symposium on Polal Instrumentation for p 128 N87-2062; view p 156 N87-2062; view p 156 N87-2062; coperation on activities p 170 N87-2062; coperation of activities p 170 N87-2062; coperation on activities p 170 N87-2062; coperation of activities p 170 N87-2062; c	57  Jal 15  hee 20  Jac 20  Ja
Study of expert system applica [NE-51-867]  Eloret Corp., Sunnyvale, Calif.  Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]  Engineering, Inc., Hampton, Va.  The results of a limited study design, fabrication, and testing of a NASA IOC space station. Executiv [NASA-CR-178276]  Engineering Mechanics Association Calif.  A computer program for model systems  ERA Ltd., Leatherhead (England).  Radiation charging and breakdor  Erno Raumfahrttechnik G.m.b.H., E Germany).  A study of fluid transfer manage [FTMS-RPT-006]  Development of experimental/a structural design verification [ESA-CR(P)-2340]  European Space Agency, Paris (Fr. Proceedings of the European Splatform Opportunities and Remote-Sensing (ESPOIR) [ESA-SP-266]  The Columbus program: An over Servicing of the polar platform USA-Europe coordination and Announcements of Opportunity Panel report on new approache Panel report on new approaches	tions to space project p 115 N87-260 ability of a concepturehicle p 92 A87-496 of approaches to the advanment p 8 N87-210; on, Inc., Torrance, verification of dynam p 31 N87-227; who of insulators p 143 N87-269; gremen (West ment in space p 97 N87-260; analytical concepts for p 161 N87-260; instrumentation for p 128 N87-262; view p 156 N87-2662; one p 156 N87-2663; instrumentation: Ner p 161 N87-2063; instrumentation in the p 161 N87-2063; ins	57  15  15  16  16  17  18  18  18  18  18  18  18  18  18
Study of expert system applica [NE-51-867]  Eloret Corp., Sunnyvale, Calif.  Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]  Engineering, Inc., Hampton, Va.  The results of a limited study design, fabrication, and testing of a NASA IOC space station. Executiv [NASA-CR-178276]  Engineering Mechanics Association Calif.  A computer program for model systems  ERA Ltd., Leatherhead (England).  Radiation charging and breakdor  Erno Raumfahrttechnik G.m.b.H., E Germany).  A study of fluid transfer manage [FTMS-RPT-006]  Development of experimental/a structural design verification [ESA-CR(P)-2340]  European Space Agency, Paris (Fr. Proceedings of the European Splatform Opportunities and Remote-Sensing (ESPOIR) [ESA-SP-266]  The Columbus program: An over Servicing of the polar platform USA-Europe coordination and Announcements of Opportunity Panel report on multidisciplinary possibilities  Panel report on new approache validation	ability of a concepturehicle p 92 A87-496 of approaches to the adynamic model of the summary p 8 N87-210; n, Inc., Torrance, verification of dynamic p 31 N87-227; who of insulators p 143 N87-269; gremen (West ment in space p 97 N87-260; analytical concepts for p 36 N87-260; analytical concepts for p 36 N87-260; analytical concepts for p 36 N87-260; and p 156 N87-2062; concepts for p 156 N87-2062; instrumentation: Ner p 156 N87-2062; instrumentation: Ner p 161 N87-2063; instrumentation: N	57  Jal 15  he 20  Jac
Study of expert system applica [NE-51-867]  Eloret Corp., Sunnyvale, Calif.  Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]  Engineering, Inc., Hampton, Va.  The results of a limited study design, fabrication, and testing of a NASA IOC space station. Executiv [NASA-CR-178276]  Engineering Mechanics Association Calif.  A computer program for model systems  ERA Ltd., Leatherhead (England).  Radiation charging and breakdor  Erno Raumfahrttechnik G.m.b.H., E Germany).  A study of fluid transfer manage [ETMS-RPT-006]  Development of experimental/a structural design verification [ESA-CR(P)-2340]  European Space Agency, Paria (Fr. Proceedings of the European Splatform Opportunities and Remote-Sensing (ESPOIR) [ESA-SP-266]  The Columbus program: An over Servicing of the polar platform USA-Europe coordination and Announcements of Opportunity Panel report on new approache validation Proceedings of the Second Internet Pro	ability of a concepturehicle p 92 A87-496 of approaches to the adynamic model of the summary p 8 N87-210; n, Inc., Torrance, verification of dynamic p 31 N87-227; who of insulators p 143 N87-269; gremen (West ment in space p 97 N87-260; analytical concepts for p 36 N87-260; analytical concepts for p 36 N87-260; analytical concepts for p 36 N87-260; and p 156 N87-2062; concepts for p 156 N87-2062; instrumentation: Ner p 156 N87-2062; instrumentation: Ner p 161 N87-2063; instrumentation: N	57  Jal 15  he 20  Jac
Study of expert system applica [NE-51-867]  Eloret Corp., Sunnyvale, Calif.  Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]  Engineering, Inc., Hampton, Va.  The results of a limited study design, fabrication, and testing of a NASA IOC space station. Executiv [NASA-CR-178276]  Engineering Mechanics Association Calif.  A computer program for model systems  ERA Ltd., Leatherhead (England).  Radiation charging and breakdor  Erno Raumfahrttechnik G.m.b.H., E Germany).  A study of fluid transfer manage [FTMS-RPT-006]  Development of experimental/a structural design verification [ESA-CR(P)-2340]  European Space Agency, Paris (Fr. Proceedings of the European Splatform Opportunities and Remote-Sensing (ESPOIR) [ESA-SP-266]  The Columbus program: An over Servicing of the polar platform USA-Europe coordination and Announcements of Opportunity Panel report on multidisciplinary possibilities  Panel report on new approache validation	tions to space project p 115 N87-260 ability of a concepturehicle p 92 A87-496 of approaches to the advanment of the summary p 8 N87-210; on, Inc., Torrance, verification of dynam p 31 N87-227: who of insulators p 143 N87-269; or analytical concepts for p 160 N87-260; or analytical concepts for p 161 N87-2062 p 136 N87-2062 p 136 N87-2062 cooperation activities p 161 N87-2063 es to calibration and p 157 N87-2063 analytical concepts for p 161 N87-2063 es to calibration and p 157 N87-2063 analytical concepts for p 161 N87-2063 es to calibration and p 157 N87-2063 analytical concepts for p 161 N87-2063 es to calibration and p 157 N87-2063 analytical concepts for p 161 N87-2063 es to calibration and p 157 N87-2063 analytical concepts for p 161 N87-2063 es to calibration and p 157 N87-2063 analytical concepts for p 161 N87-2063 es to calibration and p 157 N87-2063 analytical concepts for p 161 N87-2063 es to calibration and p 157 N87-2063 es to calibration and p 1	57 ual 15 hee 20 lico 54 8 or 5 arc 1 38 s:2 w 7 d 8 in
Study of expert system applica [NE-51-867]  Eloret Corp., Sunnyvale, Calif. Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]  Engineering, Inc., Hampton, Va. The results of a limited study design, fabrication, and testing of a NASA IOC space station. Executiv [NASA-CR-178276]  Engineering Mechanics Associatio Calif. A computer program for model systems  ERA Ltd., Leatherhead (England). Radiation charging and breakdor  Erno Raumfahrttechnik G.m.b.H., E Germany). A study of fluid transfer manage [FTMS-RPT-006] Development of experimental/a structural design verification [ESA-CR(P)-2340]  European Space Agency, Paris (Fr. Proceedings of the European Splatform Opportunities and Remote-Sensing (ESPOIR) [ESA-SP-266] The Columbus program: An over Servicing of the polar platform USA-Europe coordination and Announcements of Opportunity Panel report on multidisciplinary possibilities Panel report on new approache validation Proceedings of the Second Intern Spacecraft Flight Dynamics [ESA-SP-255]	tions to space project p 115 N87-260 ability of a concepturehicle p 92 A87-496 of approaches to the advancie model of the summary p 8 N87-210; m, Inc., Torrance, verification of dynam p 31 N87-227; who of insulators p 143 N87-269; gremen (West ment in space p 97 N87-260; analytical concepts for p 168 N87-260; analytical concepts for p 168 N87-260; analytical concepts for p 168 N87-2062; view p 156 N87-2062; view p 156 N87-2062; view p 156 N87-2063; instrumentation: Ner p 161 N87-2063; instrumentation: Ner p 161 N87-2063; as to calibration and p 157 N87-2063; attional Symposium of p 171 N87-2535	57 ual 15 hee 20 nic0 54 88 or 75 arc 1 238 s: 2 w 7 d 8 n 4
Study of expert system applica [NE-51-867]  Eloret Corp., Sunnyvale, Calif.  Synergetic plane-change cap aeromaneuvering-orbital-transfer v [AIAA PAPER 87-2565]  Engineering, Inc., Hampton, Va.  The results of a limited study design, fabrication, and testing of a NASA IOC space station. Executiv [NASA-CR-178276]  Engineering Mechanics Association Calif.  A computer program for model systems  ERA Ltd., Leatherhead (England).  Radiation charging and breakdor  Erno Raumfahrttechnik G.m.b.H., E Germany).  A study of fluid transfer manage [FTMS-RPT-006]  Development of experimental/a structural design verification [ESA-CR(P)-2340]  European Space Agency, Paris (Fr. Proceedings of the European Spattorm Opportunities and Remote-Sensing (ESPOIR) [ESA-SP-266]  The Columbus program: An over Servicing of the polar platform USA-Europe coordination and Announcements of Opportunity Panel report on multidisciplinary possibilities  Panel report on new approache validation  Proceedings of the Second Intern Spacecraft Flight Dynamics	tions to space project p 115 N87-260 ability of a concepturehicle p 92 A87-496 of approaches to the advancie model of the summary p 8 N87-210; m, Inc., Torrance, verification of dynam p 31 N87-227; who of insulators p 143 N87-269; gremen (West ment in space p 97 N87-260; analytical concepts for p 168 N87-260; analytical concepts for p 168 N87-260; analytical concepts for p 168 N87-2062; view p 156 N87-2062; view p 156 N87-2062; view p 156 N87-2063; instrumentation: Ner p 161 N87-2063; instrumentation: Ner p 161 N87-2063; as to calibration and p 157 N87-2063; attional Symposium of p 171 N87-2535	57 July 15 hee 20 Jico 54 Bor 75 arr 21 38 s:2 w 7 d Bon 14 n

E

Eι

	Hamilton Standard Div., United Aircraft Corp.
European Space Agency. ESRIN, Frascati (Italy).	General Electric Co., Philadelphia, Pa.
Payload data management scheme planned for Earth	Science Research Facilities - Versatility for Space
observation sensors to be flown on the polar platforms in the framework of the space station/Columbus	Station [SAE PAPER 860958] p 119 A87-38742
program p 114 N87-20630	The multi-disciplinary design study. A life cycle cost
Data management panel report p 114 N87-20639	algorithm [NASA-CR-178192] p 9 N87-21995
European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk	[NASA-GR-178192] p 9 N87-21995 Impact of space station appendage vibrations on the
(Netherlands).	pointing performance of gimballed payloads
The Earth observation activities of the European Space Agency and the use of the polar platform of the	p 32 N87-22733 System technology analysis of aeroassisted orbital
International Space Station p 128 N87-20622	transfer vehicles. Moderate lift/drag (0.75-1.5). Volume 1A,
Working group on Earth observation requirements for	part 1: Executive summary, phase 1
the Polar Orbiting Platform Elements of the International	[NASA-CR-179139] p 97 N87-26062 System technology analysis of aeroassisted orbital
Space Station (the POPE Working Group) p 128 N87-20625	transfer vehicles. Moderate lift/drag (0.75-1.5): Volume 1A,
ESA Columbus polar platform design concept	part 2: Executive summary, phase 2 [NASA-CR-179140] p 3 N87-26063
p 156 N87-20627	System technology analysis of aeroassisted orbital
Orbit configurations p 156 N87-20629 Cooperation of the International Space Station partners	transfer vehicles: Moderate lift/drag (0.75-1.5). Volume 3:
in the preparation of the use of space station elements	Cost estimates and work breakdown structure/dictionary, phase 1 and 2
for Earth observation (platform and payload aspects)	[NASA-CR-179144] p 3 N87-26064
p 128 N87-20631 The orbit configuration panel report	System technology analysis of aeroassisted orbital
p 157 N87-20640	transfer vehicles: Moderate lift/drag (0.75-1.5). Volume 2: Supporting research and technology report, phase 1 and
Panel report on the polar platform servicing approach	2
and its implications p 136 N87-20641	[NASA-CR-179143] p 3 N87-26065
Electrostatic immunity of geostationary satellites p 143 N87-26957	System technology analysis of aeroassisted orbital transfer vehicles: Moderate lift/drag (0.75-1.5), volume 1B,
Summary of recent SAR instrument studies	part 1, study results
p 159 N87-27865	[NASA-CR-179141] p 4 N87-26066 System technology analysis of aeroassisted orbital
Stopping differential charging of solar arrays p 83 N87-28984	transfer vehicles: Moderate lift/drag (0.75-1.5), Volume 1B,
p 83 N87-28984 Space 2000 in Europe p 159 N87-29024	part 2, study results
P 100 7101 2002	[NASA-CR-179142] p 4 N87-26067 General Electric Co., Schenectady, N.Y.
F	Flexible system model reduction and control system
	design based upon actuator and sensor influence functions p 59 A87-46301
airchild Space and Electronics Co., Germantown, Md. Space Infrared Telescope Facility/Multimission Modular	tunctions p 59 A87-46301 Genoa Univ. (Italy).
Spacecraft Attitude Control System conceptual design	Organic Rankine cycle power conversion systems for
[AAS PAPER 86-031] p 56 A87-32736	space applications p 159 N87-28989  George Washington Univ., Washington, D.C.
ord Aerospace and Communications Corp., College Park, Md.	Computational procedures for evaluating the sensitivity
Integrated scheduling and resource management	derivatives of vibration frequencies and Eigenmodes of
[AIAA PAPER 87-2213] p 119 A87-48597 raunhofer-inst. fuer Kurzzeitdynamik, Weil am Rhein	framed structures [NASA-CR-4099] p 40 N87-29899
(West Germany).	Georgia inst. of Tech., Atlanta.
Micrometeorite impact on solar panels	Evaluation of Space Station thermal control
p 82 N87-28981	techniques [SAE PAPER 860998] p 42 A87-38775
G	Experiences with the Lanczos method on a parallel
<b>u</b>	computer p 21 A87-41159
alveston Coll., Tex.	Optimal heading change with minimum energy loss for a hypersonic gliding vehicle
Expansion of space station diagnostic capability to include serological identification of viral and bacterial	[AIAA PAPER 87-2568] p 136 A87-49618
infections p 53 N87-26703	Studies in nonlinear structural dynamics: Chaotic
arrett Engine Co., Phoenix, Ariz.	behavior and poynting effect p 26 N87-20348
Nuclear propulsion systems for orbit transfer based on the particle bed reactor	Development of an emulation-simulation thermal control model for space station application
[DE87-010060] p 99 N87-28405	[NASA-CR-181009] p 45 N87-26072
eneral Accounting Office, Washington, D. C. Space operations: NASA's use of information	Vibration control of flexible structures using piezoelectric devices as sensors and actuators p 37 N87-26387
technology. Report to the Chairman, Committee on	Singular perturbation analysis of AOTV related trajectory
Science, Space and Technology [GAO/IMTEC-87-20] p 137 N87-22551	optimization problems
[GAO/IMTEC-87-20] p 137 N87-22551 eneral Dynamics Corp., Fort Worth, Tex.	[NASA-CR-180301] p 137 N87-26927 Development of an emulation-simulation thermal control
Large spacecraft pointing and shape control	model for space station application
p 69 N87-24498 eneral Dynamics Corp., Huntsville, Ala.	[NASA-CR-180312] p 45 N87-26936
Orbital transfer vehicle concept definition and system	Development of an emulation-simulation thermal control model for space station application
analysis study. Volume 1A: Executive summary. Phase 2 [NASA-CR-179055] p 161 N87-21018	[NASA-CR-181221] p 45 N87-27702
[NASA-CR-179055] p 161 N87-21018 eneral Dynamics Corp., San Diego, Calif.	Grumman Aerospace Corp., Bethpage, N.Y.
National space transportation studies	Advanced orbital servicing capabilities development [SAE PAPER 860992] p 134 A87-38769
[SAE PAPER 861681] p 160 A87-32598 Evaluation of cryogenic system test options for the OTV	Thermal test results of the two-phase thermal bus
on-orbit propellant depot	technology demonstration loop
[AIAA PAPER 87-1498] p 90 A87-43027	[AIAA PAPER 87-1627] p 44 A87-43125
Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger	LI
[AIAA PAPER 87-1540] p 44 A87-44843	п
Long term cryogenic storage facility systems study	Hamilton Standard, Windsor Locks, Conn.
p 94 N87-21143 Control considerations for high frequency, resonant,	Maintenance components for Space Station long life
power processing equipment used in large systems	fluid systems [SAE PAPER 861005] p 89 A87-38778
[NASA-TM-89926] p 68 N87-23690 Design and demonstrate the performance of cryogenic	[SAE PAPER 861005] p 89 A87-38778  Maintenance evaluation for space station liquid
components representative of space vehicles: Start basket	systems p 52 N87-21155

[NASA-CR-180312]	p 45	N87-26936
Development of an emulation-simul model for space station application	ation the	ermal control
[NASA-CR-181221]	p 45	N87-27702
Grumman Aerospace Corp., Bethpag	e, N.Y.	
Advanced orbital servicing capa	bilities o	levelopment
[SAE PAPER 860992]	p 134	A87-38769
Thermal test results of the two-p technology demonstration loop	hase t	nermal bus
[AIAA PAPER 87-1627]	p 44	A87-43125
н		
п		
Hamilton Standard, Windsor Locks, ( Maintenance components for Spa fluid systems		on long life
[SAE PAPER 861005]	p 89	A87-38778
Maintenance evaluation for sp	ace sta	ation liquid
systems	p 52	N87-21155
Hamilton Standard Div., United Aircra Locks, Conn.	ift Corp	., Windsor
An advanced carbon reactor sul	osystem	for carbon
[SAE PAPER 860995]	p 51	A87-38772
		C-3

•		
Harris Corp., Melbourne, Fla.	On orbit damage assessment for large space	Production of pulsed atomic oxygen beams via laser vaporization methods p 109 N87-26190
OPUS: Optimal Projection for Uncertain Systems	structures [AIAA PAPER 87-0870] p 15 A87-33634	vaporization methods p 109 N87-26190  An electrically conductive thermal control surface for
[AD-A176820] p 29 N87-21025	[AIAA PAPER 87-0870] p 15 A87-33634  Dynamical response to pulse excitations in large space	spacecraft encountering Low-Earth Orbit (LEO) atomic
Maximum Entropy/Optimal Projection (MEOP) control design synthesis: Optimal quantification of the major design	structures	oxygen indium tin oxide-coated thermal blankets
tradeoffs p 9 N87-22741	[AIAA PAPER 87-0710] p 15 A87-33658	p 45 N87-26192
Harris Government Aerospace Systems Div.,	System identification of a truss type space structure	Martin Marietta atomic oxygen Low Earth Orbit (LEO)
Melbourne, Fla.	using the multiple boundary condition test (MBCT) method	simulation p 142 N87-26204
Multiple beam phased array for Space Station Control	[AIAA PAPER 87-0746] p 16 A87-33670	Advanced photovoltaic solar array design assessment p 80 N87-26429
Zone Communications p 85 A87-45519	On the control of flexible structures by applied thermal	MAX: A space station computer option
Harvard-Smithsonian Center for Astrophysics, Cambridge, Mass.	gradients	p 116 N87-29146
A three-mass tethered system for micro-g/variable-g	[AIAA PAPER 87-0887] p 16 A87-33706 Positive position feedback control for large space	Flight array processor p 116 N87-29148
applications p 125 A87-40859	structures	JPL future missions and energy storage technology
Honeywell, Inc., Clearwater, Fla.	[AIAA PAPER 87-0902] p 17 A87-33711	implications p 84 N87-29917
Automated Subsystem Control for Life Support System	On sine dwell or broadband methods for modal testing	Johns Hopkins Univ., Laurel, Md.
(ASCLSS) [NASA-CR-172003] p 53 N87-29117	[AIAA PAPER 87-0961] p 18 A87-33752	Configuration tradeoffs for the space infrared telescope facility pointing control system p 121 A87-32236
Honeywell Systems and Research Center, Minneapolis,	Optimal placement of excitations and sensors for verification of large dynamical systems	Space Infrared Telescope Facility/Multimission Modular
Minn.	[AIAA PAPER 87-0782] p 19 A87-33755	Spacecraft Attitude Control System conceptual design
Robust control for large space antennas	Design considerations for long-lived glass mirrors for	[AAS PAPER 86-031] p 56 A87-32736
p 87 N87-24499	space p 123 A87-36531	Joint Oceanographic Inst., Inc., Washington, D.C.
Howard Univ., Washington, D. C.  A review of modelling techniques for the open and	Geosynchronous earth orbit base propulsion - Electric propulsion options	A crisis in the NASA space and earth sciences programme p 112 A87-37968
closed-loop dynamics of large space systems	[AIAA PAPER 87-0990] p 89 A87-38004	programme p 112 A87-3/988  Joint Publications Research Service, Arlington, Va.
p 12 A87-32337	Tethers in space; Proceedings of the International	Space biology and medicine on the twenty-fifth
Tethers in space; Proceedings of the International	Conference, Arlington, VA, Sept. 17-19, 1986	anniversary of the first spaceflight of Yuriy Alekseyevich
Conference, Arlington, VA, Sept. 17-19, 1986	p 123 A87-38567	Gagarin p 157 N87-20732
p 123 A87-38567	A survey of tether applications to planetary exploration [AAS PAPER 86-206] p 123 A87-38568	Evaluation of physical work capacity of cosmonauts aboard Salvut-6 station p 157 N87-20735
Minimum time attitude slewing maneuvers of a rigid	Tether power supplies exploiting the characteristics of	
spacecraft [NASA-CR-181130] p 72 N87-26038	space	Status of orbital astronomy projects p 128 N87-21973
The dynamics and control of large flexible space	[AAS PAPER 86-227] p 123 A87-38571	Plans for industrialization of space discussed
structures X, part 1	Production of pulsed atomic oxygen beams via laser vaporization methods p 106 A87-38625	p 157 N87-21979
(NASA-CR-181287) p 73 N87-27712	Degradation studies of SMRM teflon	USSR Report: Space
Hughes Aircraft Co., Los Angeles, Calif.	p 106 A87-38641	[JPRS-USP-86-004] p 158 N87-27687
Modeling of environmentally induced transients within	Space environmental effects on adhesives for the	Pravda commentary, photos of Mir orbital station
satellites [AIAA PAPER 85-0387] p 7 A87-41611	Galileo spacecraft p 139 A87-38643 Control of flexible structures by applied thermal	p 158 N87-27688
Hughes Aircraft Co., Torrance, Calif.	gradients p 21 A87-39543	IKI department head on orbital power plants p 158 N87-27693
High capacity demonstration of honeycomb panel heat	Nuclear reactor power for an electrically powered orbital	Progress in theory, technology of space materials
pipes (SAF PAPER 861833) p 41 A87-32666	transfer vehicle	science p 158 N87-27695
[SAE PAPER 861833] p 41 A87-32666	[AIAA PAPER 87-1102] p 76 A87-41145	Optimizing experimental programs in operational
•	Advanced propulsion activities in the USA p 90 A87-41575	planning of research carried out from spacecraft
		p 160 N87-29553
WT December 1 Chicago III	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817	p 160 No7-2955
IIT Research Inst., Chicago, III.	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando,	p 160 N67-29555
Space stable thermal control coatings	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986	L
Space stable thermal control coatings [AD-A182796] p 110 N87-28584 ###################################	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176	L  Lawrence Livermore National Lab., Calif.
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  ### N87-28584  #### N87-28584  ##################################	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184	Lawrence Livermore National Lab., Calif. Toward the year 2000: The near future of the American
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  ##################################	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging	Lawrence Livermore National Lab., Calif. Toward the year 2000: The near future of the American civilian and military space programs
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  ### N87-28584	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185	Lawrence Livermore National Lab., Calif. Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  ##################################	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture	Lawrence Livermore National Lab., Calif. Toward the year 2000: The near future of the American civilian and military space programs
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  ##################################	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) p 126 A87-44187 Flexible system model reduction and control system	Lawrence Livermore National Lab., Calif. Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697 Life Systems, Inc., Cleveland, Ohlo. EDC development and testing for the Space Station program
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  ### N87-28584	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) p 126 A87-44187 Flexible system model reduction and control system design based upon actuator and sensor influence	Lawrence Livermore National Lab., Calif.  Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697  Life Systems, Inc., Cleveland, Ohio.  EDC development and testing for the Space Station program [SAE PAPER 860918] p 118 A87-38710
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  Illinois Univ., Urbana.  Tracking and pointing maneuvers with slew-excited deformation shaping [AIAA PAPER 87-2599] p 62 A87-50561 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412 Indian Inst. of Science, Bangalore.  Dynamics of an actively controlled flexible Earth	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) p 126 A87-44187 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301	Lawrence Livermore National Lab., Calif.  Toward the year 2000: The near future of the American civilian and military space programs  [DE87-006467] p 171 N87-22697  Life Systems, Inc., Cleveland, Ohlo.  EDC development and testing for the Space Station program  [SAE PAPER 860918] p 118 A87-38710  A Space Station utility - Static Feed Electrolyzer
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  **Illinois Univ., Urbana.**  Tracking and pointing maneuvers with slew-excited deformation shaping [AIAA PAPER 87-2599] p 62 A87-50561  SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  **Indian Inst. of Science, Bangalore.**  Dynamics of an actively controlled flexible Earth observation satellite  p 71 N87-25356	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) p 126 A87-44187 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 On the inadequacies of current multi-flexible body	Lawrence Livermore National Lab., Calif. Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697 Life Systems, Inc., Cleveland, Ohio. EDC development and testing for the Space Station program [SAE PAPER 860918] p 118 A87-38710 A Space Station utility - Static Feed Electrolyzer [SAE PAPER 860920] p 47 A87-38712
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  ### N87-28586  ### N87-28586	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) p 126 A87-44187 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 On the inadequacies of current multi-flexible body simulation codes	Lawrence Livermore National Lab., Calif.  Toward the year 2000: The near future of the American civilian and military space programs  [DE87-006467] p 171 N87-22697  Life Systems, Inc., Cleveland, Ohlo.  EDC development and testing for the Space Station program  [SAE PAPER 860918] p 118 A87-38710  A Space Station utility - Static Feed Electrolyzer
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  #### N87-28584  ##################################	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) p 126 A87-44187 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412 Structural qualification of large spacecraft	Lawrence Livermore National Lab., Calif. Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697 Life Systems, Inc., Cleveland, Ohlo. EDC development and testing for the Space Station program [SAE PAPER 860918] p 118 A87-38710 A Space Station utility - Static Feed Electrolyzer [SAE PAPER 860920] p 47 A87-38712 Environmental Control Life Support for the Space Station [SAE PAPER 860944] p 48 A87-38731
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  illinois Univ., Urbana.  Tracking and pointing maneuvers with slew-excited deformation shaping [AIAA PAPER 87-2599] p 62 A87-50561 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  Indian Inst. of Science, Bangalore.  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Indian Space Research Organization, Bangalore.  Design and fabrication of Stretched Rohini Satellite-1 solar array p 83 N87-29006  Industrieanlagen-Betriebsgeselischaft m.b.H.,	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) p 126 A87-44187 Plexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412 Structural qualification of large spacecraft	Lawrence Livermore National Lab., Calif.  Toward the year 2000: The near future of the American civilian and military space programs  [DE87-006467] p 171 N87-22697  Life Systems, Inc., Cleveland, Ohlo.  EDC development and testing for the Space Station program  [SAE PAPER 860918] p 118 A87-38710  A Space Station utility - Static Feed Electrolyzer  [SAE PAPER 860920] p 47 A87-38712  Environmental Control Life Support for the Space Station  [SAE PAPER 860944] p 48 A87-38731  Integrated air revitalization system for Space Station
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  ##################################	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412 Structural qualification of large spacecraft p 26 N87-20361 Modal test and analysis: Multiple tests concept for	Lawrence Livermore National Lab., Calif.  Toward the year 2000: The near future of the American civilian and military space programs  [DE87-006467] p 171 N87-22697  Life Systems, Inc., Cleveland, Ohio.  EDC development and testing for the Space Station program  [SAE PAPER 860918] p 118 A87-38710  A Space Station utility - Static Feed Electrolyzer  [SAE PAPER 860920] p 47 A87-38731  Environmental Control Life Support for the Space Station  [SAE PAPER 860944] p 48 A87-38731  Integrated air revitalization system for Space Station  [SAE PAPER 860946] p 48 A87-38733
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  illinois Univ., Urbana.  Tracking and pointing maneuvers with slew-excited deformation shaping [AIAA PAPER 87-2599] p 62 A87-50561 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  indian inst. of Science, Bangalore.  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  indian Space Research Organization, Bangalore.  Design and fabrication of Stretched Rohini Satellite-1 solar array p 83 N87-29006  industrieanlagen-Betriebsgeselischaft m.b.H., Ottobrunn (West Germany).  Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20368	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) p 126 A87-44187 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412 Structural qualification of large spacecraft p 26 N87-20361 Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical	Lawrence Livermore National Lab., Calif. Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697 Life Systems, Inc., Cleveland, Ohlo. EDC development and testing for the Space Station program [SAE PAPER 860918] p 118 A87-38710 A Space Station utility - Static Feed Electrolyzer [SAE PAPER 860920] p 47 A87-38712 Environmental Control Life Support for the Space Station [SAE PAPER 860944] p 48 A87-38731 Integrated air revitalization system for Space Station [SAE PAPER 860946] p 48 A87-38733 Environmental control and life support technologies for
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  illinois Univ., Urbana.  Tracking and pointing maneuvers with slew-excited deformation shaping [AIAA PAPER 87-2599] p 62 A87-50561 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  Indian Inst. of Science, Bangalore.  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Indian Space Research Organization, Bangalore.  Design and fabrication of Stretched Rohini Satellite-1 solar array Industribeniagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).  Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20368 Multi-axis vibration tests on spacecraft using hydraulic	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412 Structural qualification of large spacecraft Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models Verification of large beam-type space structures	Lawrence Livermore National Lab., Calif.  Toward the year 2000: The near future of the American civilian and military space programs  [DE87-006467] p 171 N87-22697  Life Systems, Inc., Cleveland, Ohio.  EDC development and testing for the Space Station program  [SAE PAPER 860918] p 118 A87-38710  A Space Station utility - Static Feed Electrolyzer  [SAE PAPER 860920] p 47 A87-38731  Environmental Control Life Support for the Space Station  [SAE PAPER 860944] p 48 A87-38731  Integrated air revitalization system for Space Station  [SAE PAPER 860946] p 48 A87-38733
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  ##################################	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) p 126 A87-44187 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412 Structural qualification of large spacecraft p 26 N87-20361 Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models p 8 N87-20581 Verification of large beam-type space structures	Lawrence Livermore National Lab., Calif. Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697 Lite Systems, Inc., Cleveland, Ohlo. EDC development and testing for the Space Station program [SAE PAPER 860918] p 118 A87-38710 A Space Station utility - Static Feed Electrolyzer [SAE PAPER 860920] p 47 A87-38712 Environmental Control Life Support for the Space Station [SAE PAPER 860944] p 48 A87-38731 Integrated air revitalization system for Space Station [SAE PAPER 860946] p 48 A87-38733 Environmental control and life support technologies for advanced manned space missions [SAE PAPER 860994] p 51 A87-38771 LinCom Corp., Los Angeles, Calif.
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  illinois Univ., Urbana.  Tracking and pointing maneuvers with slew-excited deformation shaping [AIAA PAPER 87-2599] p 62 A87-50561 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  Indian Inst. of Science, Bangalore.  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Indian Space Research Organization, Bangalore.  Design and fabrication of Stretched Rohinin Satellite-1 solar array p 83 N87-29006  Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).  Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20368  Multi-axis vibration tests on spacecraft using hydraulic exciters International Fuel Cella Corp., South Windsor, Corn.	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) p 126 A87-44187 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412 Structural qualification of large spacecraft p 26 N87-20361 Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models p 8 N87-20581 Verification of flexible structures by ground test	Lawrence Livermore National Lab., Calif. Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697 Life Systems, Inc., Cleveland, Ohlo. EDC development and testing for the Space Station program [SAE PAPER 860918] p 118 A87-38710 A Space Station utility - Static Feed Electrolyzer [SAE PAPER 860920] p 47 A87-38712 Environmental Control Life Support for the Space Station [SAE PAPER 860944] p 48 A87-38731 Integrated air revitalization system [SAE PAPER 860946] p 48 A87-38733 Environmental control and life support technologies for advanced manned space missions [SAE PAPER 860994] p 51 A87-38771 LinCom Corp., Los Angeles, Calif. FDMA system design and analysis for Space Station
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  ##################################	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) p 126 A87-44187 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412 Structural qualification of large spacecraft Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models p 8 N87-20581 Verification of large beam-type space structures p 31 N87-22712 Verification of flexible structures by ground test p 31 N87-22713	Lawrence Livermore National Lab., Calif.  Toward the year 2000: The near future of the American civilian and military space programs  [DE87-006467] p 171 N87-22697  Life Systems, Inc., Cleveland, Ohlo.  EDC development and testing for the Space Station program  [SAE PAPER 860918] p 118 A87-38710  A Space Station utility - Static Feed Electrolyzer  [SAE PAPER 860920] p 47 A87-38712  Environmental Control Life Support for the Space Station  [SAE PAPER 860944] p 48 A87-38731  Integrated air revitalization system for Space Station  [SAE PAPER 860946] p 48 A87-38733  Environmental control and life support technologies for advanced manned space missions  [SAE PAPER 860994] p 51 A87-38771  LinCom Corp., Los Angeles, Calif.  FDMA system design and analysis for Space Station p 85 A87-45483
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  ##################################	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) p 126 A87-44187 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412 Structural qualification of large spacecraft p 26 N87-20361 Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models p 8 N87-20581 Verification of flexible structures by ground test	Lawrence Livermore National Lab., Calif. Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697 Life Systems, Inc., Cleveland, Ohlo. EDC development and testing for the Space Station program [SAE PAPER 860918] p 118 A87-38710 A Space Station utility - Static Feed Electrolyzer [SAE PAPER 860920] p 47 A87-38712 Environmental Control Life Support for the Space Station [SAE PAPER 860944] p 48 A87-38731 Integrated air revitalization system [SAE PAPER 860946] p 48 A87-38733 Environmental control and life support technologies for advanced manned space missions [SAE PAPER 860994] p 51 A87-38771 LinCom Corp., Los Angeles, Calif. FDMA system design and analysis for Space Station p 85 A87-45483 Feasibility study on 8PSK, QPSK, TFM, by using CLASS for Space Station/TDRSS real measured channel
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  illinois Univ., Urbana.  Tracking and pointing maneuvers with slew-excited deformation shaping [AIAA PAPER 87-2599] p 62 A87-50561 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  Indian Inst. of Science, Bangalore.  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Indian Space Research Organization, Bangalore.  Design and fabrication of Stretched Rohini Satellite-1 solar array Industribaniagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).  Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20368 Multi-axis vibration tests on spacecraft using hydraulic exciters International Fuel Cells Corp., South Windsor, Conn. Advanced technology for extended endurance alkaline fuel cells  Development of an alkaline fuel cell subsystem [NASA-CR-172002] p 81 N87-28188	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) p 126 A87-44187 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412 Structural qualification of large spacecraft p 26 N87-20361 Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models p 8 N87-20581 Verification of flexible structures by ground test p 31 N87-22712 Verification of flexible structures by ground test p 31 N87-22713 Structural dynamics system model reduction p 32 N87-22727 Modeling of controlled flexible structures with impulsive	Lawrence Livermore National Lab., Calif.  Toward the year 2000: The near future of the American civilian and military space programs  [DE87-006467] p 171 N87-22697  Life Systems, Inc., Cleveland, Ohlo.  EDC development and testing for the Space Station program  [SAE PAPER 860918] p 118 A87-38710  A Space Station utility - Static Feed Electrolyzer  [SAE PAPER 860920] p 47 A87-38712  Environmental Control Life Support for the Space Station  [SAE PAPER 860944] p 48 A87-38731  Integrated air revitalization system for Space Station  [SAE PAPER 860946] p 48 A87-38733  Environmental control and life support technologies for advanced manned space missions  [SAE PAPER 860994] p 51 A87-38771  LinCom Corp., Los Angeles, Calif.  FDMA system design and analysis for Space Station p 85 A87-45483  Feasibility study on 8PSK, QPSK, TFM, by using CLASS for Space Station/TDRSS real measured channel
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  ##################################	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) p 126 A87-44187 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412 Structural qualification of large spacecraft p 26 N87-20361 Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models Verification of large beam-type space structures p 31 N87-22712 Verification of flexible structures by ground test p 31 N87-22713 Structural dynamics system model reduction p 32 N87-22727 Modeling of controlled flexible structures with impulsive loads	Lawrence Livermore National Lab., Calif. Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p. 171 N87-22697 Life Systems, Inc., Cleveland, Ohlo. EDC development and testing for the Space Station program [SAE PAPER 860918] p. 118 A87-38710 A Space Station utility - Static Feed Electrolyzer [SAE PAPER 860920] p. 47 A87-38731 Environmental Control Life Support for the Space Station [SAE PAPER 860944] p. 48 A87-38731 Integrated air revitalization system for Space Station [SAE PAPER 860946] p. 48 A87-38733 Environmental control and life support technologies for advanced manned space missions [SAE PAPER 860994] p. 51 A87-38731 LinCom Corp., Los Angeles, Calif. FDMA system design and analysis for Space Station p. 85 A87-45483 Feasibility study on 8PSK, QPSK, TFM, by using CLASS for Space Station/TDRSS real measured channel p. 113 A87-45485 Little (Arthur D.), Inc., Cambridge, Mass.
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  illinois Univ., Urbana.  Tracking and pointing maneuvers with slew-excited deformation shaping [AIAP APPER 87-2599] p 62 A87-50561 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  Indian Inst. of Science, Bangalore.  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Indian Space Research Organization, Bangalore.  Design and fabrication of Stretched Rohini Satellite-1 solar array p 83 N87-29006  Industrieanlagen-Betriebsgesellschaft m.b.H.,  Ottobrunn (West Germany).  Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20388  Multi-axis vibration tests on spacecraft using hydraulic exciters  International Fuel Cells Corp., South Windsor, Conn.  Advanced technology for extended endurance alkaline fuel cells  Development of an alkaline fuel cell subsystem  [NASA-CR-172002] p 81 N87-28188  Advanced fuel cell concepts for future NASA missions p 99 N87-29930  lows Univ., lows City.	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) p 126 A87-44187 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412 Structural qualification of large spacecraft p 26 N87-20361 Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models p 8 N87-20581 Verification of large beam-type space structures p 31 N87-22712 Verification of flexible structures by ground test p 31 N87-22713 Structural dynamics system model reduction p 32 N87-22727 Modeling of controlled flexible structures with impulsive loads p 33 N87-22745 On the control of structures by applied thermal	Lawrence Livermore National Lab., Calif. Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697 Life Systems, Inc., Cleveland, Ohlo. EDC development and testing for the Space Station program [SAE PAPER 860918] p 118 A87-38710 A Space Station utility - Static Feed Electrolyzer [SAE PAPER 860920] p 47 A87-38712 Environmental Control Life Support for the Space Station [SAE PAPER 860944] p 48 A87-38731 Integrated air revitalization system [SAE PAPER 860946] p 48 A87-38733 Environmental control and life support technologies for advanced manned space missions [SAE PAPER 860994] p 51 A87-38771 LinCom Corp., Los Angeles, Calif. FDMA system design and analysis for Space Station p 85 A87-45483 Feasibility study on 8PSK, QPSK, TFM, by using CLASS for Space Station/TDRSS real measured channel p 113 A87-45485 Little (Arthur D.), Inc., Cambridge, Mass. Space Station Food System
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  illinois Univ., Urbana.  Tracking and pointing maneuvers with slew-excited deformation shaping [AIAA PAPER 87-2599] p 62 A87-50561 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  Indian Inst. of Science, Bangalore.  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356 Indian Space Research Organization, Bangalore.  Design and fabrication of Stretched Rohini Satellite-1 solar array Industribaniagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).  Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20368 Multi-axis vibration tests on spacecraft using hydraulic exciters  International Fuel Cells Corp., South Windsor, Conn. Advanced technology for extended endurance alkaline fuel cells  Development of an alkaline fuel cell subsystem [NASA-CR-172002] p 81 N87-2938 Advanced fuel cell concepts for future NASA missions p 99 N87-29930 iowa Univ., lowa City.  Shape design sensitivity analysis and optimal design of	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) p 126 A87-44187 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412 Structural qualification of large spacecraft p 26 N87-20361 Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models p 8 N87-20581 Verification of flexible structures by ground test p 31 N87-22712 Verification of flexible structures by ground test p 31 N87-22713 Structural dynamics system model reduction p 32 N87-22727 Modeling of controlled flexible structures with impulsive loads p 33 N87-22745 On the control of structures by applied thermal gradients	Lawrence Livermore National Lab., Calif. Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697 Life Systems, Inc., Cleveland, Ohlo. EDC development and testing for the Space Station program [SAE PAPER 860918] p 118 A87-38710 A Space Station utility - Static Feed Electrolyzer [SAE PAPER 860920] p 47 A87-38712 Environmental Control Life Support for the Space Station [SAE PAPER 860944] p 48 A87-38731 Integrated air revitalization system for Space Station [SAE PAPER 860946] p 48 A87-38733 Environmental control and life support technologies for advanced manned space missions [SAE PAPER 860994] p 51 A87-38771 LinCom Corp., Los Angeles, Calif. FDMA system design and analysis for Space Station p 85 A87-45485 Feasibility study on 8PSK, QPSK, TFM, by using CLASS for Space Station/TDRSS real measured channel p 113 A87-45485 Little (Arthur D.), Inc., Cambridge, Mass. Space Station Food System
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  ##################################	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) p 126 A87-44187 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412 Structural qualification of large spacecraft p 26 N87-20361 Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models p 8 N87-20581 Verification of large beam-type space structures p 31 N87-22712 Verification of flexible structures by ground test p 31 N87-22713 Structural dynamics system model reduction p 32 N87-22727 Modeling of controlled flexible structures with impulsive loads p 33 N87-22745 On the control of structures by applied thermal	Lawrence Livermore National Lab., Calif. Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697 Life Systems, Inc., Cleveland, Ohlo. EDC development and testing for the Space Station program [SAE PAPER 860918] p 118 A87-38710 A Space Station utility - Static Feed Electrolyzer [SAE PAPER 860920] p 47 A87-38712 Environmental Control Life Support for the Space Station [SAE PAPER 860944] p 48 A87-38731 Integrated air revitalization system for Space Station [SAE PAPER 860946] p 48 A87-38733 Environmental control and life support technologies for advanced manned space missions [SAE PAPER 860994] p 51 A87-38771 LinCom Corp., Los Angeles, Calif. FDMA system design and analysis for Space Station p 85 A87-45483 Feasibility study on 8PSK, QPSK, TFM, by using CLASS for Space Station/TDRSS real measured channel p 113 A87-45485 Little (Arthur D.), Inc., Cambridge, Mass. Space Station Food System [SAE PAPER 860930] p 48 A87-38720 Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  illinois Univ., Urbana.  Tracking and pointing maneuvers with slew-excited deformation shaping [AIAA PAPER 87-2599] p 62 A87-50561 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  Indian Inst. of Science, Bangalore.  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356 Indian Space Research Organization, Bangalore.  Design and fabrication of Stretched Rohini Satellite-1 solar array Industribaniagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).  Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20368 Multi-axis vibration tests on spacecraft using hydraulic exciters  International Fuel Cells Corp., South Windsor, Conn. Advanced technology for extended endurance alkaline fuel cells  Development of an alkaline fuel cell subsystem [NASA-CR-172002] p 81 N87-2938 Advanced fuel cell concepts for future NASA missions p 99 N87-29930 iowa Univ., lowa City.  Shape design sensitivity analysis and optimal design of	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) p 126 A87-44185 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412 Structural qualification of large spacecraft p 26 N87-20361 Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models p 8 N87-20581 Verification of flexible structures by ground test p 31 N87-22712 Verification of flexible structures by ground test p 31 N87-22713 Structural dynamics system model reduction p 32 N87-22727 Modeling of controlled flexible structures with impulsive loads p 33 N87-22745 On the control of structures by applied thermal gradients p 33 N87-22747 Control technology overview in CSI p 69 N87-24507 Antenna Technology Shuttle Experiment (ATSE)	Lawrence Livermore National Lab., Calif. Toward the year 2000: The near future of the American civilian and military space programs  [DE87-006467] p 171 N87-22697  Life Systems, Inc., Cleveland, Ohlo.  EDC development and testing for the Space Station program  [SAE PAPER 860918] p 118 A87-38710  A Space Station utility - Static Feed Electrolyzer  [SAE PAPER 860920] p 47 A87-38731  Environmental Control Life Support for the Space Station  [SAE PAPER 860944] p 48 A87-38731  Integrated air revitalization system for Space Station  [SAE PAPER 860946] p 48 A87-38733  Environmental control and life support technologies for advanced manned space missions  [SAE PAPER 860994] p 51 A87-38771  LinCom Corp., Los Angeles, Calif.  FDMA system design and analysis for Space Station p 85 A87-45483  Feasibility study on 8PSK, QPSK, TFM, by using CLASS for Space Station/TDRSS real measured channel p 113 A87-45485  Little (Arthur D.), Inc., Cambridge, Mass.  Space Station Food System  [SAE PAPER 860930] p 48 A87-38720  Lockheed Engineering and Management Services Co., Inc., Houston, Tex.  Real-time simulation for Space Station
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  illinois Univ., Urbana.  Tracking and pointing maneuvers with slew-excited deformation shaping [AIAA PAPER 87-2599] p 62 A87-50561 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  Indian Inst. of Science, Bangalore.  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Indian Space Research Organization, Bangalore.  Design and fabrication of Stretched Rohinin Satellite-1 solar array p 83 N87-29006 Industrieanlagen-Betriebsgesellschaft m.b.H.,  Ottobrunn (Weat Germany).  Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20368  Multi-axis vibration tests on spacecraft using hydraulic exciters p 8 N87-20373 International Fuel Cells Corp., South Windsor, Conn.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  Development of an alkaline fuel cell subsystem [NASA-CR-172002] p 81 N87-28188  Advanced fuel cell concepts for future NASA missions p 99 N87-29930  iowa Univ., lowa City.  Shape design sensitivity analysis and optimal design of structural systems  [NASA-CR-181095] p 37 N87-26370	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) p 126 A87-44187 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412 Structural qualification of large spacecraft p 26 N87-20361 Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models p 8 N87-20581 Verification of flexible structures by ground test p 31 N87-22712 Verification of flexible structures by ground test p 31 N87-22713 Structural dynamics system model reduction p 32 N87-22713 Structural dynamics system model reduction p 33 N87-22714 On the control of structures by applied thermal gradients p 33 N87-22747 Control technology overview in CSI p 69 N87-24508	Lawrence Livermore National Lab., Calif. Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697 Life Systems, Inc., Cleveland, Ohlo. EDC development and testing for the Space Station program [SAE PAPER 860918] p 118 A87-38710 A Space Station utility - Static Feed Electrolyzer [SAE PAPER 860920] p 47 A87-38712 Environmental Control Life Support for the Space Station [SAE PAPER 860944] p 48 A87-38731 Integrated air revitalization system for Space Station [SAE PAPER 860946] p 48 A87-38733 Environmental control and life support technologies for advanced manned space missions [SAE PAPER 860994] p 51 A87-38771 LinCom Corp., Los Angeles, Calif. FDMA system design and analysis for Space Station p 85 A87-45483 Feasibility study on 8PSK, QPSK, TFM, by using CLASS for Space Station/TDRSS real measured channel p 113 A87-45485 Little (Arthur D.), Inc., Cambridge, Mass. Space Station Food System [SAE PAPER 860930] p 48 A87-38720 Lockheed Engineering and Management Services Co., Inc., Houston, Tex. Real-time simulation for Space Station
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  ##################################	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) p 126 A87-44187 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412 Structural qualification of large spacecraft p 26 N87-20361 Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models p 8 N87-20581 Verification of large beam-type space structures p 31 N87-22712 Verification of flexible structures by ground test p 31 N87-22713 Structural dynamics system model reduction p 32 N87-22713 Structural dynamics system model reduction p 33 N87-22714 On the control of structures by applied thermal gradients p 33 N87-22747 Control technology overview in CSI p 69 N87-24507 Antenna Technology Shuttle Experiment (ATSE) p 87 N87-24508 Structural control by the use of piezoelectric active	Lawrence Livermore National Lab., Calif. Toward the year 2000: The near future of the American civilian and military space programs  [DE87-006467] p 171 N87-22697  Life Systems, Inc., Cleveland, Ohlo.  EDC development and testing for the Space Station program  [SAE PAPER 860918] p 118 A87-38710  A Space Station utility - Static Feed Electrolyzer  [SAE PAPER 860920] p 47 A87-38731  Environmental Control Life Support for the Space Station  [SAE PAPER 860944] p 48 A87-38731  Integrated air revitalization system for Space Station  [SAE PAPER 860946] p 48 A87-38733  Environmental control and life support technologies for advanced manned space missions  [SAE PAPER 860994] p 51 A87-38771  LinCom Corp., Los Angeles, Calif.  FDMA system design and analysis for Space Station p 85 A87-45483  Feasibility study on 8PSK, QPSK, TFM, by using CLASS for Space Station/TDRSS real measured channel p 113 A87-45485  Little (Arthur D.), Inc., Cambridge, Mass.  Space Station Food System  [SAE PAPER 860930] p 48 A87-38720  Lockheed Engineering and Management Services Co., Inc., Houston, Tex.  Real-time simulation for Space Station
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  illinois Univ., Urbana.  Tracking and pointing maneuvers with slew-excited deformation shaping [AIAA PAPER 87-2599] p 62 A87-50561 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  Indian Inst. of Science, Bangalore.  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Indian Space Research Organization, Bangalore.  Design and fabrication of Stretched Rohini Satellite-1 solar array p 83 N87-29006  Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).  Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20368  Multi-axis vibration tests on spacecraft using hydraulic exciters p 8 N87-20373  International Fuel Cells Corp., South Windsor, Conn.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  Development of an alkaline fuel cell subsystem [NASA-CR-172002] p 81 N87-28188  Advanced fuel cell concepts for future NASA missions p 99 N87-29930  iowa Univ., Iowa City.  Shape design sensitivity analysis and optimal design of structural systems [NASA-CR-181095] p 37 N87-26370	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412 Structural qualification of large spacecraft p 26 N87-20361 Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models Verification of large beam-type space structures p 31 N87-22712 Verification of flexible structures by ground test p 31 N87-22713 Structural dynamics system model reduction p 32 N87-22727 Modeling of controlled flexible structures with impulsive loads p 33 N87-22745 On the control of structures by applied thermal gradients p 33 N87-22747 Control technology overview in CSI p 69 N87-24507 Antenna Technology Shuttle Experiment (ATSE) p 67 N87-24508 Structural control by the use of piezoelectric active members p 69 N87-24509	Lawrence Livermore National Lab., Calif. Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697 Life Systems, Inc., Cleveland, Ohlo. EDC development and testing for the Space Station program [SAE PAPER 860918] p 118 A87-38710 A Space Station utility - Static Feed Electrolyzer [SAE PAPER 860920] p 47 A87-38712 Environmental Control Life Support for the Space Station [SAE PAPER 860944] p 48 A87-38731 Integrated air revitalization system for Space Station [SAE PAPER 860946] p 48 A87-38733 Environmental control and life support technologies for advanced manned space missions [SAE PAPER 860994] p 51 A87-38731 LinCom Corp., Los Angeles, Calif. FDMA system design and analysis for Space Station p 85 A87-45483 Feasibility study on 8PSK, QPSK, TFM, by using CLASS for Space Station/TDRSS real measured channel p 113 A87-45485 Little (Arthur D.), Inc., Cambridge, Mass. Space Station Food System [SAE PAPER 860930] p 48 A87-38720 Lockheed Engineering and Management Services Co., Inc., Houston, Tex. Real-time simulation for Space Station p 7 A87-37298 Space Station Food System [SAE PAPER 860930] p 48 A87-38720 Crew activity and motion effects on the space station
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  illinois Univ., Urbana.  Tracking and pointing maneuvers with slew-excited deformation shaping [AIAA PAPER 87-2599] p 62 A87-50561 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  Indian Inst. of Science, Bangalore.  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Indian Space Research Organization, Bangalore.  Design and fabrication of Stretched Rohinin Satellite-1 solar array p 83 N87-29006 Industrieanlagen-Betriebsgesellschaft m.b.H.,  Ottobrunn (Weat Germany).  Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20368  Multi-axis vibration tests on spacecraft using hydraulic exciters p 8 N87-20373 International Fuel Cells Corp., South Windsor, Conn.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  Development of an alkaline fuel cell subsystem [NASA-CR-172002] p 81 N87-28188  Advanced fuel cell concepts for future NASA missions p 99 N87-29930  iowa Univ., lowa City.  Shape design sensitivity analysis and optimal design of structural systems  [NASA-CR-181095] p 37 N87-26370	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) p 126 A87-44187 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412 Structural qualification of large spacecraft p 26 N87-20361 Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models p 8 N87-20581 Verification of flexible structures by ground test p 31 N87-22712 Verification of flexible structures by ground test p 31 N87-22713 Structural dynamics system model reduction p 32 N87-22727 Modeling of controlled flexible structures with impulsive loads p 33 N87-22774 Control technology overview in CSI p 69 N87-24507 Antenna Technology Shuttle Experiment (ATSE) p 87 N87-24508 Structural control by the use of piezoelectric active members p 69 N87-24509 Ground test of large flexible structures	Lawrence Livermore National Lab., Calif. Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697 Life Systems, Inc., Cleveland, Ohlo. EDC development and testing for the Space Station program [SAE PAPER 860918] p 118 A87-38710 A Space Station utility - Static Feed Electrolyzer [SAE PAPER 860920] p 47 A87-38712 Environmental Control Life Support for the Space Station [SAE PAPER 860944] p 48 A87-38731 Integrated air revitalization system for Space Station [SAE PAPER 860946] p 48 A87-38733 Environmental control and life support technologies for advanced manned space missions [SAE PAPER 860994] p 51 A87-38771 LinCom Corp., Los Angeles, Calif. FDMA system design and analysis for Space Station p 85 A87-45483 Feasibility study on 8PSK, QPSK, TFM, by using CLASS for Space Station/TDRSS real measured channel p 113 A87-45485 Little (Arthur D.), Inc., Cambridge, Mass. Space Station Food System [SAE PAPER 860930] p 48 A87-38720 Lockheed Engineering and Management Services Co., Inc., Houston, Tex. Real-time simulation for Space Station  p 7 A87-37298 Space Station Food System [SAE PAPER 860930] p 48 A87-38720 Crew activity and motion effects on the space station p 165 N87-22744
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  Illinois Univ., Urbana.  Tracking and pointing maneuvers with slew-excited deformation shaping [AIAA PAPER 87-2599] p 62 A87-50561 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412 Indian Inst. of Science, Bangalore.  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356 Indian Space Research Organization, Bangalore.  Design and fabrication of Stretched Rohini Satellite-1 solar array p 83 N87-29006 Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).  Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20368  Multi-axis vibration tests on spacecraft using hydraulic exciters p 8 N87-20373 International Fuel Cells Corp., South Windsor, Conn.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  Development of an alkaline fuel cell subsystem [NASA-CR-172002] p 81 N87-28188  Advanced fuel cell concepts for future NASA missions p 99 N87-29930  Iowa Univ., Iowa City.  Shape design sensitivity analysis and optimal design of structural systems [NASA-CR-181095] p 37 N87-26370  Jet Propulsion Lab., California Inst. of Tech., Passadena.  Validation of large space structures by ground tests	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) p 126 A87-44187 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412 Structural qualification of large spacecraft p 26 N87-20361 Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models p 8 N87-20581 Verification of flexible structures by ground test p 31 N87-22712 Verification of flexible structures by ground test p 31 N87-22713 Structural dynamics system model reduction p 32 N87-22713 Control technology overview in CSI p 69 N87-22747 Control technology overview in CSI p 69 N87-24508 Structural control by the use of piezoelectric active members p 69 N87-24509 Ground test of large flexible structures p 69 N87-24509 Ground test of large flexible structures	Lawrence Livermore National Lab., Calif. Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697 Life Systems, Inc., Cleveland, Ohlo. EDC development and testing for the Space Station program [SAE PAPER 860918] p 118 A87-38710 A Space Station utility - Static Feed Electrolyzer [SAE PAPER 860920] p 47 A87-38712 Environmental Control Life Support for the Space Station [SAE PAPER 860944] p 48 A87-38731 Integrated air revitalization system for Space Station [SAE PAPER 860946] p 48 A87-38733 Environmental control and life support technologies for advanced manned space missions [SAE PAPER 860994] p 51 A87-38771 LinCom Corp., Los Angeles, Calif. FDMA system design and analysis for Space Station p 85 A87-45485 Feasibility study on 8PSK, QPSK, TFM, by using CLASS for Space Station Food System [SAE PAPER 860930] p 48 A87-38720 Lockheed Engineering and Management Services Co., Inc., Houston, Tex. Real-time simulation for Space Station p 7 A87-37298 Space Station Food System [SAE PAPER 860930] p 48 A87-38720 Crew activity and motion effects on the space station p 165 N87-22744 Lockheed Missiles and Space Co., Greenbelt, Md.
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  Illinois Univ., Urbana.  Tracking and pointing maneuvers with slew-excited deformation shaping [AIAP APPER 87-2599] p 62 A87-50561 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  Indian Inst. of Science, Bangalore.  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Indian Space Research Organization, Bangalore.  Design and fabrication of Stretched Rohinin Satellite-1 solar array p 83 N87-29006  Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).  Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20368  Multi-axis vibration tests on spacecraft using hydraulic exciters p 8 N87-20373  International Fuel Cells Corp., South Windsor, Conn.  Advanced technology for extended endurance alkaline fuel cells  Development of an alkaline fuel cell subsystem [NASA-CR-172002] p 81 N87-28930  Iowa Univ., Iowa City.  Shape design sensitivity analysis and optimal design of structural systems [NASA-CR-181095] p 37 N87-26370  Jet Propulsion Lab., California Inst. of Tech., Pasadens.  Validation of large space structures by ground tests p 11 A87-32336	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) p 126 A87-44187 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412 Structural qualification of large spacecraft p 26 N87-20361 Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models p 8 N87-20581 Verification of flexible structures by ground test p 31 N87-22712 Verification of flexible structures by ground test p 31 N87-22713 Structural dynamics system model reduction p 32 N87-22727 Modeling of controlled flexible structures with impulsive loads p 33 N87-22774 Control technology overview in CSI p 69 N87-24507 Antenna Technology Shuttle Experiment (ATSE) p 87 N87-24508 Structural control by the use of piezoelectric active members p 69 N87-24509 Ground test of large flexible structures	Lawrence Livermore National Lab., Calif. Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p. 171 N87-22697 Life Systems, Inc., Cleveland, Ohlo. EDC development and testing for the Space Station program [SAE PAPER 860918] p. 118 A87-38710 A Space Station utility - Static Feed Electrolyzer [SAE PAPER 860920] p. 47 A87-38712 Environmental Control Life Support for the Space Station [SAE PAPER 860944] p. 48 A87-38731 Integrated air revitalization system for Space Station [SAE PAPER 860946] p. 48 A87-38733 Environmental control and life support technologies for advanced manned space missions [SAE PAPER 860941] p. 51 A87-38731 LinCom Corp., Los Angeles, Calif. FDMA system design and analysis for Space Station p. 85 A87-45483 Feasibility study on 8PSK, QPSK, TFM, by using CLASS for Space Station/TDRSS real measured channel p. 113 A87-45485 Little (Arthur D.), Inc., Cambridge, Mass. Space Station Food System [SAE PAPER 860930] p. 48 A87-38720 Lockheed Engineering and Management Services Co., Inc., Houston, Tex. Real-time simulation for Space Station p. 7 A87-37298 Space Station Food System [SAE PAPER 860930] p. 48 A87-38720 Crew activity and motion effects on the space station p. 165 N87-22744 Lockheed Missiles and Space Co., Greenbelt, Md. The dynamics and control of the Space Station polar
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  illinois Univ., Urbana.  Tracking and pointing maneuvers with slew-excited deformation shaping [AIAA PAPER 87-2599] p 62 A87-50561 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  Indian Inst. of Science, Bangalore.  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Indian Space Research Organization, Bangalore.  Design and fabrication of Stretched Rohini Satellite-1 solar array p 83 N87-29006  Industrieanlagen-Betriebsgesellschaft m.b.H.,  Ottobrunn (West Germany).  Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20368  Multi-axis vibration tests on spacecraft using hydraulic exciters p 8 N87-20373  International Fuel Cells Corp., South Windsor, Conn.  Advanced technology for extended endurance alkaline fuel cells usbsystem  [NASA-CR-172002] p 81 N87-28188  Advanced fuel cell concepts for future NASA missions p 99 N87-29930  lowa Univ., lowa City.  Shape design sensitivity analysis and optimal design of structural systems  [NASA-CR-181095] p 37 N87-26370  Jet Propulsion Lab., California Inst. of Tech.,  Pasadena.  Validation of large space structures by ground tests p 11 A87-32336  Static shape control for flexible structures	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) p 126 A87-44187 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412 Structural qualification of large spacecraft p 26 N87-20361 Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models p 8 N87-20581 Verification of flexible structures by ground test p 31 N87-22712 Verification of flexible structures by ground test p 31 N87-22713 Structural dynamics system model reduction p 32 N87-22745 On the control of structures by applied thermal gradients p 33 N87-22745 Control technology overview in CSI p 69 N87-24507 Antenna Technology Shuttle Experiment (ATSE) p 87 N87-24508 Structural control by the use of piezoelectric active members Ground test of large flexible structures p 34 N87-24509 Ground test of large flexible structures p 69 N87-24509 Ground test of large flexible structures p 79 N87-24509 Ground test of large flexible structures p 80 N87-24509 Ground test of large flexible structures p 94 N87-24509 Ground test of large flexible structures p 94 N87-24509 Ground test of large flexible structures p 97 N87-24509 Ground test of large flexible structures p 98 N87-24509 Ground test of large flexible structures p 98 N87-24509 Ground test of large flexible structures p 98 N87-24509 Ground test of large flexible structures p 98 N87-24509 Ground test of large flexible structures p 98 N87-24509 Ground test of large flexible structures p 98 N87-24509 Ground test	Lawrence Livermore National Lab., Calif. Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697 Life Systems, Inc., Cleveland, Ohlo. EDC development and testing for the Space Station program [SAE PAPER 860918] p 118 A87-38710 A Space Station utility - Static Feed Electrolyzer [SAE PAPER 860920] p 47 A87-38712 Environmental Control Life Support for the Space Station [SAE PAPER 860944] p 48 A87-38731 Integrated air revitalization system for Space Station [SAE PAPER 860946] p 48 A87-38733 Environmental control and life support technologies for advanced manned space missions [SAE PAPER 860994] p 51 A87-38771 LinCom Corp., Los Angeles, Calif. FDMA system design and analysis for Space Station p 85 A87-45485 Feasibility study on 8PSK, QPSK, TFM, by using CLASS for Space Station Food System [SAE PAPER 860930] p 48 A87-38720 Lockheed Engineering and Management Services Co., Inc., Houston, Tex. Real-time simulation for Space Station p 7 A87-37298 Space Station Food System [SAE PAPER 860930] p 48 A87-38720 Crew activity and motion effects on the space station p 165 N87-22744 Lockheed Missiles and Space Co., Greenbelt, Md.
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  illinois Univ., Urbana.  Tracking and pointing maneuvers with slew-excited deformation shaping [AIAA PAPER 87-2599] p 62 A87-50561 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  Indian Inst. of Science, Bangalore.  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Indian Space Research Organization, Bangalore.  Design and fabrication of Stretched Rohini Satellite-1 solar array p 83 N87-29006  Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).  Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20368  Multi-axis vibration tests on spacecraft using hydraulic exciters p 8 N87-20373  International Fuel Cells Corp., South Windsor, Conn.  Advanced technology for extended endurance alkaline fuel cells p 75 A87-33787  Development of an alkaline fuel cell subsystem [NASA-CR-172002] p 81 N87-28188  Advanced fuel cell concepts for future NASA missions p 99 N87-29930  iowa Univ., Iowa City.  Shape design sensitivity analysis and optimal design of structural systems [NASA-CR-181095] p 37 N87-26370  Jet Propulsion Lab., California Inst. of Tech., Passadena.  Validation of large space structures by ground tests p 11 A87-32336  Static shape control for flexible structures  SAE PAPER 861822) p 13 A87-32658	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) p 126 A87-44187 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412 Structural qualification of large spacecraft Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models p 8 N87-20581 Verification of flexible structures by ground test p 31 N87-22712 Verification of flexible structures by ground test p 31 N87-22713 Structural dynamics system model reduction p 32 N87-22713 Control technology overview in CSI  Antenna Technology Shuttle Experiment (ATSE) p 87 N87-24507 Antenna Technology Shuttle Experiment (ATSE) p 87 N87-24509 Ground test of large flexible structures p 69 N87-24509 Ground test of large flexible structures p 79 N87-24509 Ground test of large flexible structures p 79 N87-24509 Ground test of large flexible structures p 69 N87-24509 Ground test of large flexible structures p 79 N87-2588 Proceedings of the NASA Workshop on Atomic Oxygen	Lawrence Livermore National Lab., Calif. Toward the year 2000: The near future of the American civilian and military space programs [DE87-006467] p 171 N87-22697 Life Systems, Inc., Cleveland, Ohlo. EDC development and testing for the Space Station program [SAE PAPER 860918] p 118 A87-38710 A Space Station utility - Static Feed Electrolyzer [SAE PAPER 860920] p 47 A87-38712 Environmental Control Life Support for the Space Station [SAE PAPER 860944] p 48 A87-38731 Integrated air revitalization system for Space Station [SAE PAPER 860946] p 48 A87-38731 Environmental control and life support technologies for advanced manned space missions [SAE PAPER 860946] p 51 A87-38731 Environmental control and life support technologies for advanced manned space missions [SAE PAPER 860994] p 51 A87-38771 LinCom Corp., Los Angeles, Calif. FDMA system design and analysis for Space Station p 85 A87-45483 Feasibility study on 8PSK, QPSK, TFM, by using CLASS for Space Station/TDRSS real measured channel p 85 A87-45485 Little (Arthur D.), Inc., Cambridge, Mass. Space Station Food System [SAE PAPER 860930] p 48 A87-38720 Lockheed Engineering and Management Services Co., Inc., Houston, Tex. Real-time simulation for Space Station p 7 A87-37298 Space Station Food System [SAE PAPER 860930] p 48 A87-38720 Crew activity and motion effects on the space station p 165 N87-22744 Lockheed Missiles and Space Co., Greenbelt, Md. The dynamics and control of the Space Station polar platform [AIAA PAPER 87-2600] p 62 A87-50562 Lockheed Missiles and Space Co., Palo Aito, Calif.
Space stable thermal control coatings [AD-A182796] p 110 N87-28584  illinois Univ., Urbana.  Tracking and pointing maneuvers with slew-excited deformation shaping [AIAA PAPER 87-2599] p 62 A87-50561 SAGA: A project to automate the management of software production systems [NASA-CR-180276] p 10 N87-27412  Indian Inst. of Science, Bangalore.  Dynamics of an actively controlled flexible Earth observation satellite p 71 N87-25356  Indian Space Research Organization, Bangalore.  Design and fabrication of Stretched Rohini Satellite-1 solar array p 83 N87-29006  Industrieanlagen-Betriebsgesellschaft m.b.H.,  Ottobrunn (West Germany).  Spacecraft qualification using advanced vibration and modal testing techniques p 27 N87-20368  Multi-axis vibration tests on spacecraft using hydraulic exciters p 8 N87-20373  International Fuel Cells Corp., South Windsor, Conn.  Advanced technology for extended endurance alkaline fuel cells usbsystem  [NASA-CR-172002] p 81 N87-28188  Advanced fuel cell concepts for future NASA missions p 99 N87-29930  lowa Univ., lowa City.  Shape design sensitivity analysis and optimal design of structural systems  [NASA-CR-181095] p 37 N87-26370  Jet Propulsion Lab., California Inst. of Tech.,  Pasadena.  Validation of large space structures by ground tests p 11 A87-32336  Static shape control for flexible structures	Soft mounted momentum compensated pointing system for the Space Shuttle Orbiter p 59 A87-42817 Remote sensing; Proceedings of the Meeting, Orlando, FL, Apr. 3, 4, 1986 [SPIE-644] p 125 A87-44176 Earth resources instrumentation for the Space Station Polar Platform p 126 A87-44184 Conceptual design of the High-Resolution Imaging Spectrometer (HIRIS) for EOS p 126 A87-44185 The Earth Observing System (EOS) synthetic aperture radar (SAR) p 126 A87-44187 Flexible system model reduction and control system design based upon actuator and sensor influence functions p 59 A87-46301 On the inadequacies of current multi-flexible body simulation codes [AIAA PAPER 87-2248] p 7 A87-50412 Structural qualification of large spacecraft p 26 N87-20361 Modal test and analysis: Multiple tests concept for improved validation of large space structure mathematical models p 8 N87-20581 Verification of flexible structures by ground test p 31 N87-22712 Verification of flexible structures by ground test p 31 N87-22713 Structural dynamics system model reduction p 32 N87-22745 On the control of structures by applied thermal gradients p 33 N87-22745 Control technology overview in CSI p 69 N87-24507 Antenna Technology Shuttle Experiment (ATSE) p 87 N87-24508 Structural control by the use of piezoelectric active members Ground test of large flexible structures p 34 N87-24509 Ground test of large flexible structures p 69 N87-24509 Ground test of large flexible structures p 79 N87-24509 Ground test of large flexible structures p 80 N87-24509 Ground test of large flexible structures p 94 N87-24509 Ground test of large flexible structures p 94 N87-24509 Ground test of large flexible structures p 97 N87-24509 Ground test of large flexible structures p 98 N87-24509 Ground test of large flexible structures p 98 N87-24509 Ground test of large flexible structures p 98 N87-24509 Ground test of large flexible structures p 98 N87-24509 Ground test of large flexible structures p 98 N87-24509 Ground test of large flexible structures p 98 N87-24509 Ground test	Lawrence Livermore National Lab., Calif. Toward the year 2000: The near future of the American civilian and military space programs  [DE87-006467] p 171 N87-22697  Life Systems, Inc., Cleveland, Ohlo.  EDC development and testing for the Space Station program  [SAE PAPER 860918] p 118 A87-38710  A Space Station utility - Static Feed Electrolyzer  [SAE PAPER 860920] p 47 A87-38712  Environmental Control Life Support for the Space Station  [SAE PAPER 860944] p 48 A87-38731  Integrated air revitalization system for Space Station  [SAE PAPER 860946] p 48 A87-38733  Environmental control and life support technologies for advanced manned space missions  [SAE PAPER 860994] p 51 A87-38771  LinCom Corp., Los Angeles, Calif.  FDMA system design and analysis for Space Station p 85 A87-45485  Little (Arthur D.), Inc., Cambridge, Mass.  Space Station Food System  [SAE PAPER 860930] p 48 A87-38720  Lockheed Engineering and Management Services Co., Inc., Houston, Tex.  Real-time simulation for Space Station p 7 A87-37298  Space Station Food System  [SAE PAPER 860930] p 48 A87-38720  Crew activity and motion effects on the space station p 165 N87-22744  Lockheed Missiles and Space Co., Greenbelt, Md.  The dynamics and control of the Space Station polar platform  [AIAA PAPER 87-2600] p 62 A87-50562

Spacecraft ram glow and surface temperature p 10 N87-26205

O-atom degradation mechanisms of materials p 141 N87-26178

charging

AAS PAPER 86-007] p 56 A87-32732 Spacecraft dielectric material properties and spacecraft harging p 105 A87-33100

CORPORATE SOURCE
Lockheed Missiles and Space Co., Sunnyvale, Calif.
Science and payload options for animal and plant
research accommodations aboard the early Space Station
[SAE PAPER 860953] p 164 A87-38740
Vibration isolation for line of sight performance improvement p 67 N87-22742
Preliminary design, analysis, and costing of a dynamic
scale model of the NASA space station
[NASA-CR-4068] p 36 N87-25606 Test results from the solar array flight experiment
p 83 N87-29010
.os Alamos National Lab., N. Mex. Radiation shielding requirements on long-duration space
missions
[AD-A177512] p 140 N87-21991
Nuclear reactor power for a space-based radar, SP-100 project
[NASA-TM-89295] p 79 N87-25838
unar and Planetary Inst., Houston, Tex.  A crisis in the NASA space and earth sciences
programme p 112 A87-37968
M
Innecement and Tachnical Complete Co. House
lanagement and Technical Services Co., Houston, Tex.
Conceptual planning for Space Station life sciences
human research project [SAE PAPER 860969] p 164 A87-38751
Concepts for the evolution of the Space Station
Program
[SAE PAPER 860972] p 120 A87-38754 arconi Space Systems Ltd., Portsmouth (England).
GaAs concentrator solar arrays p 82 N87-28977
artin Marietta Aerospace, Denver, Colo.
Benefits of passive damping as applied to active control of large space structures p 63 N87-20371
Near-field testing of the 5-meter model of the tetrahedral
truss antenna [NASA-CR-178147] p 30 N87-21987
Space station structural dynamics/reaction control
system interaction study p 67 N87-22753
Box truss antenna technology status p 87 N87-24503
Propulsion recommendations for space station free
flying platforms p 98 N87-26129
artin Marietta Corp., Denver, Colo. Shuttle middeck fluid transfer experiment: Lessons
learned p 95 N87-21158
artin Marietta Energy Systems, Inc., Oak Ridge, Tenn.
Traction-drive, seven-degree-of-freedom telerobot arm: A concept for manipulaton in space p 104 N87-29867
aryland Univ., College Park.
Dynamic finite element modeling of flexible structures
[AD-A177168] p 30 N87-22252 assachusetts Inst. of Tech., Cambridge.
A crisis in the NASA space and earth sciences
p 112 A87-37968
The radiation impedance of an electrodynamic tether with end connectors p 125 AB7-42585
Flexible system model reduction and control system
design based upon actuator and sensor influence
unctions p 59 A87-46301  Material damping in aluminum and metal matrix
composites p 106 A87-49797
The coupled dynamics of fluids and spacecraft in low
gravity and low gravity fluid measurement
A preliminary study of extended magnetic field structures
n the ionosphere
NASA-CR-181004] p 140 N87-23066 Development of intelligent structures using finite control
elements in a hierarchic and distributed control system
AD-A179711] p 72 N87-25805
Joint nonlinearity effects in the design of a flexible truss tructure control system
NASA-CR-180633] p 37 N87-26365
Design of a mixed fleet transportation system to low arth orbit. Volume 1: Executive summary. Volume 2:
arth orbit. Volume 1: Executive summary. Volume 2:
lear-term shuttle replacement. Volume 3: Heavy-lift cargo ehicle. Volume 4: Advanced technology shuttle
eplacement p 5 N87-29583
seachusetts Univ., Amherst.
Dynamic and thermal effects in very large space tructures p 25 N87-20347
TRA Espace, Paris-Velizy (France).
Study of data management system architecture options

MA

[MATRA-RF/176/0932-ISS-1]

MATRA Espace, Toulouse (France).

Qualification of the faint object camera

p 115 N87-28586

p 127 N87-20359

The Space Station overview

The evolution of the geostationary platform concept

p 168 A87-41571

p 125 A87-43154

```
Maxwell Labs., Inc., San Diego, Calif.
    Ram ion scattering caused by Space Shuttle v x B induced differential charging p 140 A87-51713
  McDonnell-Douglas Astronautics Co., Houston, Tex.
      The dynamics and control of the Space Station polar
    [AIAA PAPER 87-2600]
                                          p 62 A87-50562
  McDonnell-Douglas Astronautics Co., Huntington
    Beach, Calif.
      The use of multidimensional scaling for facilities layout
     An application to the design of the Špace Station
                                         p 118 A87-33003
      Space Station galley design
   [SAE PAPER 860932]
                                         p 119 A87-38722
     Analysis of crew functions as an aid in Space Station
   interior layout
[SAE PAPER 8609341
  McDonnell-Douglas Astronautics Co., St. Louis Mo.
     Advanced EVA system design requirements study:
   EVAS/space station system interface requirements
   [NASA-CR-171981]
                                        p 120 N87-20351
  Messerschmitt-Boelkow-Blohm/Entwicklungspring
   Nord, Bremen (West Germany).
     Recent developments and future trends in structural
   dynamic design verification and qualification of large
   flexible spacecraft
                                        p 156 N87-20357
     Study of data management system architecture options
   for space station
   [MATRA-RF/176/0932-ISS-1]
                                        p 115 N87-28586
   esserschmitt-Boelkow-Biohm G.m.b.H., Ottobrunn
   (West Germany).
     Stress and deformation analysis of lightweight
   composite structures
   [MBB-UD-489/86]
                                         p 30 N87-22269
     Botanical payloads for platforms and space stations
   [MBB-UR-E-921/86]
                                       p 158 N87-25340
     Possibilities of the further development of Columbus to
   an autonomous European space station
   [MBB-UR-E-922/86]
                                        p 158 N87-25418
  Fiber composites in satellites
[MBB-UD-492/86]
                                        p 107 N87-25430
     The Radarsat Modular Opto-electronic Multispectral
   Scanner (R-MOMS): A potential candidate for the Polar
   Orbiting Platform (POP) also
   [MBB-UR-873/86]
                                        p 130 N87-25506
     The evolution of a serviceable EURECA
  [MBB-UR-E-923/86]
                                       p 121 N87-26841
    Control engineering tasks in the framework of the
  Columbus program
  [MBB-UR-E-912/86]
                                        p 158 N87-26842
 Meteorological Office, Bracknell (England).
    Ocean-ice panel report
                                       p 156 N87-20635
Michigan Univ., Ann Arbor.
    Optimal nodal transfer and aeroassisted transfer by
  aerocruise
                                       p 138 N87-28577
Microsemi Corp., Torrance, Calif.
    Space station power semiconductor package
NASA-CR-180829] p 81 N87-28825
  [NASA-CR-180829]
                           N
Naples Univ. (Italy).
The tethered satellite system for low density aerothermodynamics studies p 127 A87-52450 National Academy of Sciences - National Research
  Council, Washington, D. C.
    Guidelines for noise and vibration levels for the space
  [NASA-CR-178310]
                                      p 120 N87-24162
National Aeronautical Establishment, Ottawa (Ontario).
Use of a video-photogrammetry system for the
  measurement of the dynamic response of the shuttle
  remote manipulator arm
                                      p 101 N87-20370
National Aeronautics and Space Administration,
  Washington, D.C.
    Space research - At a crossroads
                                      p 166 A87-32017
   NASA's space program - Space Station: A status report
 and a view of its value for space science
                                         p 1 A87-32277
   Overview of the NASA automation and robotics research
                                      p 100 A87-33867
 program
   A crisis in the NASA space and earth sciences
 programme
                                      p 112 A87-37968
   Tethers in space; Proceedings of the International
 Conference, Arlington, VA, Sept. 17-19, 1986
                                      p 123 A87-38567
   Technology and applications - Convergence to a tether
 [AAS PAPER 86-244]
                                      p 124 A87-38574
 Radiation dose prediction for Space Station
[SAE PAPER 860924] p 139
                                     p 139 A87-38715
```

```
Scientific customer needs - NASA user
    [AIAA PAPER 87-2196]
                                          p 119 A87-48582
       The Consultative Committee for Space Data Systems
     Standards program
    [AIAA PAPER 87-2204]
                                          p 113 A87-48589
      The Space Station software support environment - Not
    just what, but why
    [AIAA PAPER 87-2208]
                                          p 114 A87-48593
      Technical and Management
                                      Information System
    (TMIS)
    [AIAA PAPER 87-2217]
                                          p 114 A87-48600
      Future trends in spacecraft design and qualification
                                            p 2 N87-20356
      Space station: A program overview
                                         p 171 N87-24496
      Large space systems technology and requirements
                                            p 3 N87-24500
      Space station systems: A bibliography with indexes
    (supplement 4)
    [NASA-SP-7056(04)]
                                            p 4 N87-26073
      An overview of photovoltaic applications in space
                                          p 80 N87-26414
      Proceedings: Computer Science and Data Systems
    Technical Symposium, volume 1
    [NASA-TM-89285]
                                         p 116 N87-29124
      Proceedings: Computer Science and Data Systems
    Technical Symposium, volume 2
    [NASA-TM-89286]
                                         p 116 N87-29144
      Advanced local area network concepts
                                        p 117 N87-29153
 National Aeronautics and Space Administration. Ames
    Research Center, Moffett Field, Calif.
     Maximum likelihood identification using an array
      ocessor p.5 A87-32121
Design and development of a Space Station proximity
   operations research and development mockup
[SAE PAPER 861785] p 133
                                                A87-32634
                                        p 133
      Transferring superfluid helium in space
                                          p 88 A87-34712
     Integrated air revitalization system for Space Station
   [SAE PAPER 860946]
                                         p 48 A87-38733
     Science and payload options for animal and plant
   research accommodations aboard the early Space
   [SAE PAPER 860953]
                                        p 164 A87-38740
   Life Sciences Research Facility auto-
requirements and concepts for the Space Station
   [SAE PAPER 860970]
                                         p 50 A87-38752
     Life Science Research Facility materials management
   requirements and concepts
   [SAE PAPER 860974]
                                        p 124 A87-38756
     Development of a water recovery subsystem based on
   Vapor Phase Catalytic Ammonia Removal (VPCAR)
   [SAE PAPER 860985]
                                         p 50 A87-38764
     Proof that timing requirements of the FDDI token ring
   protocol are satisfied
                                       p 112 A87-42821
     Synergetic plane-change capability of a conceptual
  aeromaneuvering-orbital-transfer vehicle
[AIAA PAPER 87-2565]
                                        p 92 A87-49615
    An astrometric facility for planetary detection on the
                                        p 127 A87-50750
   Space Station
    Space Station gas-grain simulation facility - Application
                                        p 127 A87-53002
   to exobiology
    An astrometric facility for planetary detection on the
  space station
[NASA-TM-89436]
                                        p 128 N87-20841
    Helium technology issues
    Helium technology issues p 94 N87-21145
Astronomic Telescope Facility: Preliminary systems
  definition study report. Volume 2: Technical description [NASA-TM-89429-VOL-2] p.129 N87-22570
                                       p 129 N87-22570
    Astrometric Telescope Facility preliminary systems
   definition study. Volume 1: Executive summary
  [NASA-TM-89429-VOL-1]
    NASA-TM-89429-VOL-1] p 129 N87-22571
Human factors in space station architecture 2. EVA
   access facility: A comparative analysis of 4 concepts for
  on-orbit space suit servicing
  [NASA-TM-86856]
                                        p 52 N87-24064
    Workshop on Workload and Training, and Examination
  of their Interactions: Executive summary
  [NASA-TM-89459]
                                       p 171 N87-25760
    Potential energy surfaces for atomic oxygen reactions:
  Formation of singlet and triplet biradicals as primary
  reaction products with unsaturated organic molecules
                                       p 108 N87-26182
    Reactions of atomic oxygen (O(P-3)) with polybutadienes
  and related polymers
                                       p 109 N87-26197
    Potential surfaces for O atom-polymer reactions
                                      p 109 N87-26201
p 117 N87-29157
    Network reliability
National Aeronautics and Space Administration.
 Goddard Space Flight Center, Greenbelt, Md.
Space Infrared Telescope Facility/Multimission Modular
 Spacecraft Attitude Control System conceptual design
 [AAS PAPER 86-031]
                                        p 56 A87-32736
    Potential modulation on the SCATHA spacecraft
```

p 138 A87-34460

Servicing of user payload equipment in the Space Station	Manned spacecraft automation and robotics	Material interactions with the Low Earth Orbital (LEO) environment: Accurate reaction rate measurements
pressurized environment	p 100 A87-37300 Electrodynamic plasma motor/generator experiment	p 108 N87-26175
[SAE PAPER 860973] p 134 A87-38755	[AAS PAPER 86-210] p 89 A87-38569	Mass spectrometers and atomic oxygen
Actuators for actively controlled space structures p 59 A87-42816	Plasma motor/generator reference system designs for	p 141 N87-26176
Earth resources instrumentation for the Space Station	power and propulsion	High intensity 5 eV atomic oxygen source and Low Earth
Polar Platform p 126 A87-44184	[AAS PAPER 86-229] p 89 A87-38572	Orbit (LEO) simulation facility p 141 N87-26186
Preliminary system concepts for MODIS - A moderate	Space motion sickness status report [SAE PAPER 860923] p 163 A87-38714	Quality requirements for reclaimed/recycled water [NASA-TM-58279] p 53 N87-27392
resolution imaging spectrometer for EOS	Space Station Food System	[NASA-TM-58279] p 53 N87-27392 Space suit extravehicular hazards protection
p 126 A87-44186	[SAE PAPER 860930] p 48 A87-38720	development
Feasibility study on 8PSK, QPSK, TFM, by using CLASS	Space Station personal hygiene study	[NASA-TM-89355] p 53 N87-27407
for Space Station/TDRSS real measured channel p 113 A87-45485	[SAE PAPER 860931] p 163 A87-38721	Testing and analysis of DOD Ada language products
Control of robot manipulator compliance	Space Station galley design [SAE PAPER 860932] p 119 A87-38722	for NASA p 172 N87-29155
p 100 A87-45797	Regenerable non-venting thermal control subsystem for	Network operating system focus technology
Data storage systems technology for the Space Station	extravehicular activity	p 117 N87-29167
era	[SAE PAPER 860947] p 42 A87-38734	The 21st Aerospace Mechanisms Symposium [NASA-CP-2470] p 103 N87-29858
[AIAA PAPER 87-2202] p 113 A87-48587	Conceptual planning for Space Station life sciences human research project	Telerobotic work system: Concept development and
Data capture and processing [AIAA PAPER 87-2203] p 113 A87-48588	[SAE PAPER 860969] p 164 A87-38751	evolution p 104 N87-29866
Standards for the user interface - Developing a user	Concepts for the evolution of the Space Station	The preloadable vector sensitive latch for orbital
consensus	Program	docking/berthing p 162 N87-29876
[AIAA PAPER 87-2209] p 169 A87-48594	[SAE PAPER 860972] p 120 A87-38754	An electromechanical attenuator/actuator for Space Station docking p 138 N87-29878
The dynamics and control of the Space Station polar	Pre- and post-treatment techniques for spacecraft water	Station docking p 138 N87-29878 Space Station lubrication considerations
platform [AIAA PAPER 87-2600] p 62 A87-50562	recovery [SAE PAPER 860982] p 50 A87-38761	p 104 N87-29879
[AIAA PAPER 87-2600] p 62 A87-50562  The human quest in space; Proceedings of the	Results on reuse of reclaimed shower water	National Aeronautics and Space Administration.
Twenty-fourth Goddard Memorial Symposium, Greenbelt,	[SAE PAPER 860983] p 50 A87-38762	Langley Research Center, Hampton, Va.
MD, Mar. 20, 21, 1986 p 2 A87-53082	A membrane-based subsystem for very high recoveries	Robust controller synthesis for a large flexible space antenna p 84 A87-32235
Gas tungsten arc welding in a microgravity environment:	of spacecraft waste waters [SAF PAPER 860984] p 50 A87-38763	antenna p 84 A87-32235 High capacity demonstration of honeycomb panel heat
Work done on GAS payload G-169 p 136 N87-20306	[SAE PAPER 860984] p 50 A87-38763 Environmental control and life support technologies for	pipes
Superfluid helium on orbit transfer (SHOOT) p 95 N87-21151	advanced manned space missions	[SAE PAPER 861833] p 41 A87-32666
Problems in merging Earth sensing satellite data sets	[SAE PAPER 860994] p 51 A87-38771	A Lanczos eigenvalue method on a parallel computer
[NASA-TM-87820] p 129 N87-22457	An advanced carbon reactor subsystem for carbon	[AIAA PAPER 87-0725] p 13 A87-33565
TAE Plus: A conceptual view of TAE in the space station	dioxide reduction [SAE PAPER 860995] p 51 A87-38772	Integrated structural electromagnetic optimization of
era p 9 N87-23157	[SAE PAPER 860995] p 51 A87-38772 Integrated waste and water management system	large space antenna reflectors [AIAA PAPER 87-0824] p 14 A87-33611
SOT: A rapid prototype using TAE windows p 114 N87-23161	[SAE PAPER 860996] p 51 A87-38773	Optimization procedure to control the coupling of
High energy gamma ray astronomy	An improved waste collection system for space flight	vibration modes in flexible space structures
p 129 N87-24258	[SAE PAPER 861014] p 119 A87-38784	[AIAA PAPER 87-0826] p 14 A87-33613
Dynamics during thrust maneuvers of flexible spinning	The mechanics of manufacturing in space p 167 A87-40068	Quasi-static shape adjustment of a 15 meter diameter
satellites with axial and radial booms p 71 N87-25355	Experimentation in planetary geology	space antenna [AIAA PAPER 87-0869] p 15 A87-33633
Mass storage systems for data transport in the early	p 124 A87-40319	Vibration suppression using a constrained rate-feedback
space station era 1992-1998 [NASA-TM-87826] p 115 N87-27443	Advanced technology for the Space Station	Threshold control strategy
Fiber optic data systems p 117 N87-29152	p 120 A87-40353	[AIAA PAPER 87-0741] p 6 A87-33665
User interface and payload command and control	Inadequacy of single-impulse transfers for path constrained rendezyous p 90 A87-41615	Experience in distributed parameter modeling of the Spacecraft Control Laboratory Experiment (SCOLE)
p 73 N87-29162	constrained rendezvous p 90 A87-41615 Optical correlator use at Johnson Space Center	structure
User data management p 4 N87-29163 Advanced software tools space station focused	p 59 A87-42655	[AIAA PAPER 87-0895] p 16 A87-33689
technology p 5 N87-29164	The definition of the low earth orbital environment and	Dynamic and attitude control characteristics of an
SS focused technology: Gateways and NOS's	its effect on thermal control materials	International Space Station [AIAA PAPER 87-0931] p 57 A87-33731
- 447 NOT 00465		[AIAA PAPER 87-0931] p 57 A87-33731
p 117 N87-29165	[AIAA PAPER 87-1599] p 43 A87-43103	
Network operating system p 117 N87-29166	Thermal test results of the two-phase thermal bus	Effects of local vibrations on the dynamics of space
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-29916	Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125	
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-29916 National Aeronautics and Space Administration. John	Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125 Development of a prototype two-phase thermal bus	Effects of local vibrations on the dynamics of space truss structures [AIAA PAPER 87-0941] p 17 A87-33739 Thermal design of the ACCESS erectable space truss
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-29916 National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fia. Quick-disconnect inflatable seal assembly	Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125 Development of a prototype two-phase thermal bus system for Space Station	Effects of local vibrations on the dynamics of space truss structures [AIAA PAPER 87-0941] p 17 A87-33739 Thermal design of the ACCESS erectable space truss p 42 A87-34469
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-29916 National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla. Quick-disconnect inflatable seal assembly [NASA-CASE-KSC-11368-1] p 102 N87-25583	Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125 Development of a prototype two-phase thermal bus system for Space Station [AIAA PAPER 87-1628] p 44 A87-43126	Effects of local vibrations on the dynamics of space truss structures [AIAA PAPER 87-0941] p 17 A87-33739 Thermal design of the ACCESS erectable space truss p 42 A87-34469 Composite tubes for the Space Station truss structure
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-29916 National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla. Quick-disconnect inflatable seal assembly [NASA-CASE-KSC-11368-1] p 102 N87-25583 KSC Space Station Operations Language (SSOL)	Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125 Development of a prototype two-phase thermal bus system for Space Station [AIAA PAPER 87-1628] p 44 A87-43126 Structural and preliminary thermal performance testing	Effects of local vibrations on the dynamics of space truss structures [AIAA PAPER 87-0941] p 17 A87-33739 Thermal design of the ACCESS erectable space truss p 42 A87-34469 Composite tubes for the Space Station truss structure p 20 A87-38601
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-29916 National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.  Quick-disconnect inflatable seal assembly [NASA-CASE-KSC-11368-1] p 102 N87-25583 KSC Space Station Operations Language (SSOL) p 138 N87-29168	Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125 Development of a prototype two-phase thermal bus system for Space Station [AIAA PAPER 87-1628] p 44 A87-43126	Effects of local vibrations on the dynamics of space truss structures  [AIAA PAPER 87-0941] p 17 A87-33739  Thermal design of the ACCESS erectable space truss p 42 A87-34469  Composite tubes for the Space Station truss structure p 20 A87-38601  Assessment of space environment induced microdamage in toughened composite materials
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-29916  National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla. Quick-disconnect inflatable seal assembly [NASA-CASE-KSC-11368-1] p 102 N87-25583 KSC Space Station Operations Language (SSOL) p 138 N87-29168  National Aeronautics and Space Administration.	Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125 Development of a prototype two-phase thermal bus system for Space Station [AIAA PAPER 87-1628] p 44 A87-43126 Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger [AIAA PAPER 87-1540] p 44 A87-44843 FDMA system design and analysis for Space Station	Effects of local vibrations on the dynamics of space truss structures [AIAA PAPER 87-0941] p 17 A87-33739 Thermal design of the ACCESS erectable space truss p 42 A87-34469 Composite tubes for the Space Station truss structure p 20 A87-38601 Assessment of space environment induced microdamage in toughened composite materials p 20 A87-38609
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-29916 N87-29916 N87-29916 N87-29916 N87-29916 N87-29916 N87-29916 N87-29916 N87-29916 N87-29168	Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125 Development of a prototype two-phase thermal bus system for Space Station [AIAA PAPER 87-1628] p 44 A87-43126 Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger [AIAA PAPER 87-1540] p 44 A87-44843 FDMA system design and analysis for Space Station p 85 A87-45483	Effects of local vibrations on the dynamics of space truss structures  [AIAA PAPER 87-0941] p 17 A87-33739  Thermal design of the ACCESS erectable space truss p 42 A87-34469  Composite tubes for the Space Station truss structure p 20 A87-38601  Assessment of space environment induced microdamage in toughened composite materials p 20 A87-38609  Effects of varying environmental parameters on trace
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-29916 National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.  Quick-disconnect inflatable seal assembly [NASA-CASE-KSC-11368-1] p 102 N87-25583 KSC Space Station Operations Language (SSOL) p 138 N87-29168 National Aeronautics and Space Administration.  Lyndon B. Johnson Space Center, Houston, Tex.  Space Station integration and verification concepts p 84 A87-31461	Thermal test results of the two-phase thermal bus technology demonstration loop  [AIAA PAPER 87-1627] p 44 A87-43125  Development of a prototype two-phase thermal bus system for Space Station  [AIAA PAPER 87-1628] p 44 A87-43126  Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger  [AIAA PAPER 87-1540] p 44 A87-44843  FDMA system design and analysis for Space Station p 85 A87-4583  Space Station multiple access communications	Effects of local vibrations on the dynamics of space truss structures  [AIAA PAPER 87-0941] p 17 A87-33739  Thermal design of the ACCESS erectable space truss p 42 A87-34469  Composite tubes for the Space Station truss structure p 20 A87-38601  Assessment of space environment induced microdamage in toughened composite materials p 20 A87-38609  Effects of varying environmental parameters on trace contaminant concentrations in the NASA Space Station
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-2916	Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125 Development of a prototype two-phase thermal bus system for Space Station [AIAA PAPER 87-1628] p 44 A87-43126 Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger [AIAA PAPER 87-1540] p 44 A87-44843 FDMA system design and analysis for Space Station p 85 A87-45483 Space Station multiple access communications system p 86 A87-45524	Effects of local vibrations on the dynamics of space truss structures [AIAA PAPER 87-0941] p 17 A87-33739 Thermal design of the ACCESS erectable space truss p 42 A87-34469 Composite tubes for the Space Station truss structure p 20 A87-38601 Assessment of space environment induced microdamage in toughened composite materials p 20 A87-38609 Effects of varying environmental parameters on trace contaminant concentrations in the NASA Space Station Reference Configuration
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-29161 N87-29166 N87-29166 N87-29166 N87-29166 N87-29166 N87-29166 N87-29166 N87-29168	Thermal test results of the two-phase thermal bus technology demonstration loop  [AIAA PAPER 87-1627] p 44 A87-43125  Development of a prototype two-phase thermal bus system for Space Station  [AIAA PAPER 87-1628] p 44 A87-43126  Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger  [AIAA PAPER 87-1540] p 44 A87-44843  FDMA system design and analysis for Space Station p 85 A87-45483  Space Station multiple access communications system  p 86 A87-45524  Man's role in space exploration and exploitation p 169 A87-46332	Effects of local vibrations on the dynamics of space truss structures  [AIAA PAPER 87-0941] p 17 A87-33739  Thermal design of the ACCESS erectable space truss p 42 A87-34469  Composite tubes for the Space Station truss structure p 20 A87-38601  Assessment of space environment induced microdamage in toughened composite materials p 20 A87-38609  Effects of varying environmental parameters on trace contaminant concentrations in the NASA Space Station Reference Configuration  [SAE PAPER 860916] p 47 A87-38708  Supercritical water oxidation - Concept analysis for
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-29916 N87-29916 National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.  Quick-disconnect inflatable seal assembly [NASA-CASE-KSC-11368-1] p 102 N87-25583 KSC Space Station Operations Language (SSOL) p 138 N87-29168 National Aeronautics and Space Administration.  Lyndon B. Johnson Space Center, Houston, Tex.  Space Station integration and verification concepts p 84 A87-31461 Selected materials issues associated with Space Station p 105 A87-32061 Role of the manned maneuvering unit for the Space	Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125 Development of a prototype two-phase thermal bus system for Space Station [AIAA PAPER 87-1628] p 44 A87-43126 Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger [AIAA PAPER 87-1540] p 44 A87-44843 FDMA system design and analysis for Space Station p 85 A87-45483 Space Station multiple access communications system p 86 A87-45524 Man's role in space exploration and exploitation p 169 A87-46332 Space Station Information System integrated	Effects of local vibrations on the dynamics of space truss structures [AIAA PAPER 87-0941] p 17 A87-33739 Thermal design of the ACCESS erectable space truss p 42 A87-34469 Composite tubes for the Space Station truss structure p 20 A87-38601 Assessment of space environment induced microdamage in toughened composite materials p 20 A87-38609 Effects of varying environmental parameters on trace contaminant concentrations in the NASA Space Station Reference Configuration [SAE PAPER 860916] p 47 A87-38708 Supercritical water oxidation - Concept analysis for evolutionary Space Station application
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-2916	Thermal test results of the two-phase thermal bus technology demonstration loop  [AIAA PAPER 87-1627] p 44 A87-43125  Development of a prototype two-phase thermal bus system for Space Station  [AIAA PAPER 87-1628] p 44 A87-43126  Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger  [AIAA PAPER 87-1540] p 44 A87-44843  FDMA system design and analysis for Space Station p 85 A87-45483  Space Station multiple access communications system p 86 A87-45524  Man's role in space exploration and exploitation p 169 A87-46332  Space Station Information System integrated communications concept	Effects of local vibrations on the dynamics of space truss structures [AIAA PAPER 87-0941] p 17 A87-33739 Thermal design of the ACCESS erectable space truss p 42 A87-34469 Composite tubes for the Space Station truss structure p 20 A87-38601 Assessment of space environment induced microdamage in toughened composite materials p 20 A87-38609 Effects of varying environmental parameters on trace contaminant concentrations in the NASA Space Station Reference Configuration [SAE PAPER 860916] p 47 A87-38708 Supercritical water oxidation - Concept analysis for evolutionary Space Station application [SAE PAPER 860993] p 51 A87-38770
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-29161 N87-29161 N87-29161 N87-29161 N87-29161 N87-29161 N87-29161 N87-29161 N87-29161 N87-29162	Thermal test results of the two-phase thermal bus technology demonstration loop  [AIAA PAPER 87-1627] p 44 A87-43125 Development of a prototype two-phase thermal bus system for Space Station  [AIAA PAPER 87-1628] p 44 A87-43126 Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger  [AIAA PAPER 87-1540] p 44 A87-44843 FDMA system design and analysis for Space Station p 85 A87-45483 Space Station multiple access communications system  Man's role in space exploration and exploitation p 169 A87-46332 Space Station Information System integrated communications concept  [AIAA PAPER 87-2228] p 114 A87-48606	Effects of local vibrations on the dynamics of space truss structures  [AIAA PAPER 87-0941] p 17 A87-33739  Thermal design of the ACCESS erectable space truss p 42 A87-34469  Composite tubes for the Space Station truss structure p 20 A87-38601  Assessment of space environment induced microdamage in toughened composite materials p 20 A87-38609  Effects of varying environmental parameters on trace contaminant concentrations in the NASA Space Station Reference Configuration  [SAE PAPER 860916] p 47 A87-38708  Supercritical water oxidation - Concept analysis for evolutionary Space Station application  [SAE PAPER 860993] p 51 A87-38770  Evaluation of Space Station thermal control
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-2916 N97-2916 N87-2916 N87-2916 N97-2916 N97-2916 N87-2916 N97-2916 N87-2916 N87-2916 N97-2916	Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125 Development of a prototype two-phase thermal bus system for Space Station [AIAA PAPER 87-1628] p 44 A87-43126 Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger [AIAA PAPER 87-1540] p 44 A87-44843 FDMA system design and analysis for Space Station p 85 A87-45483 Space Station multiple access communications system p 86 A87-45524 Man's role in space exploration and exploitation p 169 A87-46332 Space Station Information System integrated communications concept [AIAA PAPER 87-2228] p 114 A87-48666 Space Station Information System requirements for	Effects of local vibrations on the dynamics of space truss structures [AIAA PAPER 87-0941] p 17 A87-33739 Thermal design of the ACCESS erectable space truss p 42 A87-34469 Composite tubes for the Space Station truss structure p 20 A87-38601 Assessment of space environment induced microdamage in toughened composite materials p 20 A87-38609 Effects of varying environmental parameters on trace contaminant concentrations in the NASA Space Station Reference Configuration [SAE PAPER 860916] p 47 A87-38708 Supercritical water oxidation - Concept analysis for evolutionary Space Station application [SAE PAPER 860993] p 51 A87-38770
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-2916	Thermal test results of the two-phase thermal bus technology demonstration loop  [AIAA PAPER 87-1627] p 44 A87-43125 Development of a prototype two-phase thermal bus system for Space Station  [AIAA PAPER 87-1628] p 44 A87-43126 Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger  [AIAA PAPER 87-1540] p 44 A87-44843 FDMA system design and analysis for Space Station p 85 A87-45483 Space Station multiple access communications system  Man's role in space exploration and exploitation  p 169 A87-46332 Space Station Information System integrated communications concept  [AIAA PAPER 87-2228] p 114 A87-48606 Space Station Information System requirements for integrated communications  [AIAA PAPER 87-2229] p 114 A87-48607	Effects of local vibrations on the dynamics of space truss structures  [AIAA PAPER 87-0941] p 17 A87-33739  Thermal design of the ACCESS erectable space truss p 42 A87-34469  Composite tubes for the Space Station truss structure p 20 A87-38601  Assessment of space environment induced microdamage in toughened composite materials p 20 A87-38609  Effects of varying environmental parameters on trace contaminant concentrations in the NASA Space Station Reference Configuration  [SAE PAPER 860916] p 47 A87-38708  Supercritical water oxidation - Concept analysis for evolutionary Space Station application  [SAE PAPER 860993] p 51 A87-38770  Evaluation of Space Station thermal control techniques  [SAE PAPER 860998] p 42 A87-38775  Experiences with the Lanczos method on a parallel
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-2916	Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125 Development of a prototype two-phase thermal bus system for Space Station [AIAA PAPER 87-1628] p 44 A87-43126 Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger [AIAA PAPER 87-1540] p 44 A87-44843 FDMA system design and analysis for Space Station p 85 A87-45483 Space Station multiple access communications system p 86 A87-45524 Man's role in space exploration and exploitation p 169 A87-46332 Space Station Information System integrated communications concept [AIAA PAPER 87-2228] p 114 A87-48606 Space Station Information System requirements for integrated communications [AIAA PAPER 87-2229] p 114 A87-48607 Radiation environments and absorbed dose estimations	Effects of local vibrations on the dynamics of space truss structures [AIAA PAPER 87-0941] p 17 A87-33739 Thermal design of the ACCESS erectable space truss p 42 A87-34469 Composite tubes for the Space Station truss structure p 20 A87-38601 Assessment of space environment induced microdamage in toughened composite materials p 20 A87-38609 Effects of varying environmental parameters on trace contaminant concentrations in the NASA Space Station Reference Configuration [SAE PAPER 860916] p 47 A87-38708 Supercritical water oxidation - Concept analysis for evolutionary Space Station application [SAE PAPER 860993] p 51 A87-38770 Evaluation of Space Station thermal control techniques [SAE PAPER 860998] p 42 A87-38775 Experiences with the Lanczos method on a parallel computer
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-2916	Thermal test results of the two-phase thermal bus technology demonstration loop  [AIAA PAPER 87-1627] p 44 A87-43125  Development of a prototype two-phase thermal bus system for Space Station  [AIAA PAPER 87-1628] p 44 A87-43126  Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger  [AIAA PAPER 87-1540] p 44 A87-4843  FDMA system design and analysis for Space Station p 85 A87-45483  Space Station multiple access communications system p 86 A87-45524  Man's role in space exploration and exploitation p 169 A87-46332  Space Station Information System integrated communications concept  [AIAA PAPER 87-2228] p 114 A87-48606  Space Station Information System requirements for integrated communications  [AIAA PAPER 87-2229] p 114 A87-48607  Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026	Effects of local vibrations on the dynamics of space truss structures  [AIAA PAPER 87-0941] p 17 A87-33739  Thermal design of the ACCESS erectable space truss p 42 A87-34469  Composite tubes for the Space Station truss structure p 20 A87-38601  Assessment of space environment induced microdamage in toughened composite materials p 20 A87-38609  Effects of varying environmental parameters on trace contaminant concentrations in the NASA Space Station Reference Configuration  [SAE PAPER 860916] p 47 A87-38708  Supercritical water oxidation - Concept analysis for evolutionary Space Station application  [SAE PAPER 860993] p 51 A87-38770  Evaluation of Space Station thermal control techniques  [SAE PAPER 860998] p 42 A87-38775  Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Dynamic analysis and experiment methods for a generic
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-2916	Thermal test results of the two-phase thermal bus technology demonstration loop  [AIAA PAPER 87-1627] p 44 A87-43125  Development of a prototype two-phase thermal bus system for Space Station  [AIAA PAPER 87-1628] p 44 A87-43126  Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger  [AIAA PAPER 87-1540] p 44 A87-44843  FDMA system design and analysis for Space Station p 85 A87-45483  Space Station multiple access communications system p 86 A87-45524  Man's role in space exploration and exploitation p 169 A87-46332  Space Station Information System integrated communications concept  [AIAA PAPER 87-2228] p 114 A87-48606  Space Station Information System requirements for integrated communications  [AIAA PAPER 87-2229] p 114 A87-48607  Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026  Proposed CMG momentum management scheme for	Effects of local vibrations on the dynamics of space truss structures  [AIAA PAPER 87-0941] p 17 A87-33739  Thermal design of the ACCESS erectable space truss p 42 A87-34469  Composite tubes for the Space Station truss structure p 20 A87-38601  Assessment of space environment induced microdamage in toughened composite materials p 20 A87-38609  Effects of varying environmental parameters on trace contaminant concentrations in the NASA Space Station Reference Configuration  [SAE PAPER 860916] p 47 A87-38708  Supercritical water oxidation - Concept analysis for evolutionary Space Station application  [SAE PAPER 860993] p 51 A87-38770  Evaluation of Space Station thermal control techniques  [SAE PAPER 860998] p 42 A87-38775  Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Dynamic analysis and experiment methods for a generic space station model
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-2916	Thermal test results of the two-phase thermal bus technology demonstration loop  [AIAA PAPER 87-1627] p 44 A87-43125  Development of a prototype two-phase thermal bus system for Space Station  [AIAA PAPER 87-1628] p 44 A87-43126  Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger  [AIAA PAPER 87-1540] p 44 A87-4843  FDMA system design and analysis for Space Station p 85 A87-45483  Space Station multiple access communications system p 86 A87-45524  Man's role in space exploration and exploitation p 169 A87-46332  Space Station Information System integrated communications concept  [AIAA PAPER 87-2228] p 114 A87-48606  Space Station Information System requirements for integrated communications  [AIAA PAPER 87-2229] p 114 A87-48607  Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026	Effects of local vibrations on the dynamics of space truss structures  [AIAA PAPER 87-0941] p 17 A87-33739  Thermal design of the ACCESS erectable space truss p 42 A87-34469  Composite tubes for the Space Station truss structure p 20 A87-38601  Assessment of space environment induced microdamage in toughened composite materials p 20 A87-38609  Effects of varying environmental parameters on trace contaminant concentrations in the NASA Space Station Reference Configuration  [SAE PAPER 860916] p 47 A87-38708  Supercritical water oxidation - Concept analysis for evolutionary Space Station application  [SAE PAPER 860993] p 51 A87-38770  Evaluation of Space Station thermal control techniques  [SAE PAPER 860998] p 42 A87-38775  Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Dynamic analysis and experiment methods for a generic
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-2916 National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla. Quick-disconnect inflatable seal assembly [NASA-CASE-KSC-11368-1] p 102 N87-29168 KSC Space Station Operations Language (SSOL) p 138 N87-29168 National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. Space Station integration and verification concepts p 84 A87-31461 Selected materials issues associated with Space Station p 105 A87-32061 Role of the manned maneuvering unit for the Space Station [SAE PAPER 861834] p 133 A87-32667 System level verification applying the Space Shuttle experience to the Space Station [AAS PAPER 86-041] p 95 A87-32727 Laser docking system flight experiment [AAS PAPER 86-043] p 99 A87-32745 System architecture for the telerobotic work system [AAS PAPER 86-044] p 167 A87-33019 Dynamic and attitude control characteristics of an	Thermal test results of the two-phase thermal bus technology demonstration loop  [AIAA PAPER 87-1627] p 44 A87-43125  Development of a prototype two-phase thermal bus system for Space Station  [AIAA PAPER 87-1628] p 44 A87-43126  Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger  [AIAA PAPER 87-1540] p 44 A87-44843  FDMA system design and analysis for Space Station p 85 A87-45483  Space Station multiple access communications system p 86 A87-45524  Man's role in space exploration and exploitation p 169 A87-46332  Space Station Information System integrated communications concept  [AIAA PAPER 87-2228] p 114 A87-48606  Space Station Information System requirements for integrated communications  [AIAA PAPER 87-2229] p 114 A87-48607  Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026  Proposed CMG momentum management scheme for space station  [AIAA PAPER 87-2528] p 62 A87-50531  Space station control moment gyro control	Effects of local vibrations on the dynamics of space truss structures [AIAA PAPER 87-0941] p 17 A87-33739 Thermal design of the ACCESS erectable space truss p 42 A87-34469 Composite tubes for the Space Station truss structure p 20 A87-38601 Assessment of space environment induced microdamage in toughened composite materials p 20 A87-38609 Effects of varying environmental parameters on trace contaminant concentrations in the NASA Space Station Reference Configuration [SAE PAPER 860916] p 47 A87-38708 Supercritical water oxidation - Concept analysis for evolutionary Space Station application [SAE PAPER 860993] p 51 A87-38770 Evaluation of Space Station thermal control techniques [SAE PAPER 860998] p 42 A87-38775 Experiences with the Lanczos method on a parallel computer p 21 A87-41159 Dynamic analysis and experiment methods for a generic space station model p 22 A87-41613 Interdisciplinary analysis procedures in the modeling and control of large space-based structures
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-29916 National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla. Quick-disconnect inflatable seal assembly [NASA-CASE-KSC-11368-1] p 102 N87-25583 KSC Space Station Operations Language (SSOL) p 138 N87-29168 National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. Space Station integration and verification concepts p 84 A87-31461 Selected materials issues associated with Space Station Role of the manned maneuvering unit for the Space Station [SAE PAPER 861834] p 105 A87-32061 System level verification applying the Space Shuttle experience to the Space Station [AAS PAPER 86-001] p 55 A87-32727 Laser docking system flight experiment [AAS PAPER 86-041] p 99 A87-32745 System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32746 Manned space flight p 167 A87-33019 Dynamic and attitude control characteristics of an International Space Station	Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125 Development of a prototype two-phase thermal bus system for Space Station [AIAA PAPER 87-1628] p 44 A87-43126 Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger [AIAA PAPER 87-1540] p 44 A87-44843 FDMA system design and analysis for Space Station p 85 A87-45483 Space Station multiple access communications system p 86 A87-45524 Man's role in space exploration and exploitation p 169 A87-46332 Space Station Information System integrated communications concept [AIAA PAPER 87-2228] p 114 A87-48606 Space Station Information System requirements for integrated communications [AIAA PAPER 87-2229] p 114 A87-48607 Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Proposed CMG momentum management scheme for space station [AIAA PAPER 87-2528] p 62 A87-50531 Space station control moment gyro control	Effects of local vibrations on the dynamics of space truss structures  [AIAA PAPER 87-0941] p 17 A87-33739  Thermal design of the ACCESS erectable space truss p 42 A87-34690  Composite tubes for the Space Station truss structure p 20 A87-38601  Assessment of space environment induced microdamage in toughened composite materials p 20 A87-38609  Effects of varying environmental parameters on trace contaminant concentrations in the NASA Space Station Reference Configuration  [SAE PAPER 860916] p 47 A87-38708  Supercritical water oxidation - Concept analysis for evolutionary Space Station application  [SAE PAPER 860993] p 51 A87-38770  Evaluation of Space Station thermal control techniques  [SAE PAPER 860998] p 42 A87-38775  Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Dynamic analysis and experiment methods for a generic space station model p 22 A87-41613  Interdisciplinary analysis procedures in the modeling and control of large space-based structures  p 22 A87-42678  Effects of atmosphere on slewing control of a flexible
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-2916 National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla. Quick-disconnect inflatable seal assembly [NASA-CASE-KSC-11368-1] p 102 N87-25583 KSC Space Station Operations Language (SSOL) p 138 N87-29168  National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. Space Station integration and verification concepts p 84 A87-31461 Selected materials issues associated with Space Station Role of the manned maneuvering unit for the Space Station [SAE PAPER 861834] p 133 A87-32667 System level verification applying the Space Shuttle experience to the Space Station [AAS PAPER 86-041] p 95 A87-32727 Laser docking system flight experiment [AAS PAPER 86-043] p 99 A87-32745 System architecture for the telerobotic work system [AAS PAPER 86-044] p 167 A87-33019 Dynamic and attitude control characteristics of an International Space Station [AIAA PAPER 87-0931] p 57 A87-33731 Manned spacecraft electrical power systems	Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125 Development of a prototype two-phase thermal bus system for Space Station [AIAA PAPER 87-1628] p 44 A87-43126 Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger [AIAA PAPER 87-1540] p 44 A87-44843 FDMA system design and analysis for Space Station p 85 A87-45483 Space Station multiple access communications system p 86 A87-45524 Man's role in space exploration and exploitation p 169 A87-45632 Space Station Information System integrated communications concept [AIAA PAPER 87-2228] p 114 A87-48606 Space Station Information System requirements for integrated communications [AIAA PAPER 87-2229] p 114 A87-48607 Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Proposed CMG momentum management scheme for space station [AIAA PAPER 87-2528] p 62 A87-50531 Space station control moment gyro control p 64 N87-20669 Aero-Assisted Orbital Transfer Vehicle (AOTV)	Effects of local vibrations on the dynamics of space truss structures  [AIAA PAPER 87-0941] p 17 A87-33739  Thermal design of the ACCESS erectable space truss p 42 A87-34469  Composite tubes for the Space Station truss structure p 20 A87-38601  Assessment of space environment induced microdamage in toughened composite materials  p 20 A87-38609  Effects of varying environmental parameters on trace contaminant concentrations in the NASA Space Station Reference Configuration  [SAE PAPER 860916] p 47 A87-38708  Supercritical water oxidation - Concept analysis for evolutionary Space Station application  [SAE PAPER 860993] p 51 A87-38770  Evaluation of Space Station thermal control techniques  [SAE PAPER 860998] p 42 A87-38775  Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Dynamic analysis and experiment methods for a generic space station model p 22 A87-41613  Interdisciplinary analysis procedures in the modeling and control of large space-based structures  p 22 A87-42678  Effects of atmosphere on slewing control of a flexible structure p 22 A87-47809
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-2916	Thermal test results of the two-phase thermal bus technology demonstration loop  [AIAA PAPER 87-1627] p 44 A87-43125  Development of a prototype two-phase thermal bus system for Space Station  [AIAA PAPER 87-1628] p 44 A87-43126  Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger  [AIAA PAPER 87-1540] p 44 A87-44843  FDMA system design and analysis for Space Station p 85 A87-45483  Space Station multiple access communications system p 86 A87-45524  Man's role in space exploration and exploitation p 169 A87-46332  Space Station Information System integrated communications concept  [AIAA PAPER 87-2228] p 114 A87-48606  Space Station Information System requirements for integrated communications  [AIAA PAPER 87-2229] p 114 A87-48607  Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026  Proposed CMG momentum management scheme for space station  [AIAA PAPER 87-2528] p 62 A87-50531  Space station control moment gyro control p 64 N87-20669  Aero-Assisted Orbital Transfer Vehicle (AOTV)	Effects of local vibrations on the dynamics of space truss structures  [AIAA PAPER 87-0941] p 17 A87-33739  Thermal design of the ACCESS erectable space truss p 42 A87-34469  Composite tubes for the Space Station truss structure p 20 A87-38601  Assessment of space environment induced microdamage in toughened composite materials p 20 A87-38609  Effects of varying environmental parameters on trace contaminant concentrations in the NASA Space Station Reference Configuration  [SAE PAPER 860916] p 47 A87-38708  Supercritical water oxidation - Concept analysis for evolutionary Space Station application  [SAE PAPER 860993] p 51 A87-38770  Evaluation of Space Station thermal control techniques  [SAE PAPER 860998] p 42 A87-38775  Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Dynamic analysis and experiment methods for a generic space station model p 22 A87-41613 Interdisciplinary analysis procedures in the modelling and control of large space-based structures  p 22 A87-47809  Effects of atmosphere on slewing control of a flexible structure p 22 A87-47809  Robust eigensystem assignment for flexible structures
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-29916  National Aeronautics and Space Administration. John  F. Kennedy Space Center, Cocoa Beach, Fia. Quick-disconnect inflatable seal assembly [NASA-CASE-KSC-11368-1] p 102 N87-25583 KSC Space Station Operations Language (SSOL) p 138 N87-29168  National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. Space Station integration and verification concepts p 84 A87-31461 Selected materials issues associated with Space Station p 105 A87-32061 Role of the manned maneuvering unit for the Space Station [SAE PAPER 861834] p 133 A87-32667 System level verification applying the Space Shuttle experience to the Space Station [AAS PAPER 86-043] p 5 A87-32727 Laser docking system flight experiment [AAS PAPER 86-043] p 99 A87-32745 System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32745 Manned space flight p 167 A87-33019 Dynamic and attitude control characteristics of an International Space Station [AIAA PAPER 87-0931] p 57 A87-37291 Space Station data management system architecture	Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125 Development of a prototype two-phase thermal bus system for Space Station [AIAA PAPER 87-1628] p 44 A87-43126 Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger [AIAA PAPER 87-1540] p 44 A87-44843 FDMA system design and analysis for Space Station p 85 A87-45483 Space Station multiple access communications system p 86 A87-45524 Man's role in space exploration and exploitation p 169 A87-46332 Space Station Information System integrated communications concept [AIAA PAPER 87-2228] p 114 A87-48606 Space Station Information System requirements for integrated communications [AIAA PAPER 87-2229] p 114 A87-48607 Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Proposed CMG momentum management scheme for space station [AIAA PAPER 87-2528] p 62 A87-50531 Space station control moment gyro control p 64 N87-20669 Aero-Assisted Orbital Transfer Vehicle (AOTV) p 3 N87-20682 Microgravity fluid management in two-phase thermal	Effects of local vibrations on the dynamics of space truss structures  [AIAA PAPER 87-0941] p 17 A87-33739  Thermal design of the ACCESS erectable space truss p 42 A87-34469  Composite tubes for the Space Station truss structure p 20 A87-38601  Assessment of space environment induced microdamage in toughened composite materials p 20 A87-38609  Effects of varying environmental parameters on trace contaminant concentrations in the NASA Space Station Reference Configuration  [SAE PAPER 860916] p 47 A87-38708  Supercritical water oxidation - Concept analysis for evolutionary Space Station application  [SAE PAPER 860993] p 51 A87-38770  Evaluation of Space Station thermal control techniques  [SAE PAPER 860998] p 42 A87-38775  Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Dynamic analysis and experiment methods for a generic space station model p 22 A87-41613  Interdisciplinary analysis procedures in the modeling and control of large space-based structures  [Effects of atmosphere on slewing control of a flexible structure p 22 A87-47809  Robust eigensystem assignment for flexible structures  [AIAA PAPER 87-2252] p 23 A87-50416
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-29916 National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla. Quick-disconnect inflatable seal assembly [NASA-CASE-KSC-11368-1] p 102 N87-25583 KSC Space Station Operations Language (SSOL) p 138 N87-29168 National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. Space Station integration and verification concepts p 84 A87-31461 Selected materials issues associated with Space Station p 105 A87-32061 Role of the manned maneuvering unit for the Space Station [SAE PAPER 861834] p 133 A87-32667 System level verification applying the Space Shuttle experience to the Space Station [AAS PAPER 86-041] p 95 A87-32727 Laser docking system flight experiment [AAS PAPER 86-043] p 99 A87-32745 System architecture for the telerobotic work system [AAS PAPER 86-044] p 167 A87-33019 Dynamic and attitude control characteristics of an International Space Station [AIAA PAPER 87-0931] p 57 A87-33731 Manned spacecraft electrical power systems p 75 A87-337291 Space Station data management system architecture p 1111 A87-37293	Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125 Development of a prototype two-phase thermal bus system for Space Station [AIAA PAPER 87-1628] p 44 A87-43126 Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger [AIAA PAPER 87-1540] p 44 A87-44843 FDMA system design and analysis for Space Station p 85 A87-45483 Space Station multiple access communications system p 86 A87-45524 Man's role in space exploration and exploitation p 169 A87-46332 Space Station Information System integrated communications concept [AIAA PAPER 87-2228] p 114 A87-48606 Space Station Information System requirements for integrated communications [AIAA PAPER 87-2229] p 114 A87-48607 Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Proposed CMG momentum management scheme for space station [AIAA PAPER 87-2528] p 62 A87-50531 Space station control moment gyro control p 64 N87-20669 Aero-Assisted Orbital Transfer Vehicle (AOTV) p 3 N87-20682 Microgravity fluid management in two-phase thermal	Effects of local vibrations on the dynamics of space truss structures  [AIAA PAPER 87-0941] p 17 A87-33739  Thermal design of the ACCESS erectable space truss p 42 A87-34469  Composite tubes for the Space Station truss structure p 20 A87-38601  Assessment of space environment induced microdamage in toughened composite materials p 20 A87-38609  Effects of varying environmental parameters on trace contaminant concentrations in the NASA Space Station Reference Configuration  [SAE PAPER 860916] p 47 A87-38708  Supercritical water oxidation - Concept analysis for evolutionary Space Station application  [SAE PAPER 860993] p 51 A87-38770  Evaluation of Space Station thermal control techniques  [SAE PAPER 860998] p 42 A87-38775  Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Dynamic analysis and experiment methods for a generic space station model p 22 A87-41613 Interdisciplinary analysis procedures in the modeling and control of large space-based structures  [Effects of atmosphere on slewing control of a flexible structure P 22 A87-47809  Robust eigensystem assignment for flexible structures [AIAA PAPER 87-2252] p 23 A87-50416  Single-mode projection filters for identification and state estimation of flexible structures
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-29916  National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla. Quick-disconnect inflatable seal assembly [NASA-CASE-KSC-11368-1] p 102 N87-29168  National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. Space Station integration and verification concepts p 84 A87-31461  Selected materials issues associated with Space Station Role of the manned maneuvering unit for the Space Station [SAE PAPER 861834] p 133 A87-32667 System level verification applying the Space Shuttle experience to the Space Station [AAS PAPER 86-041] p 55 A87-32727 Laser docking system flight experiment [AAS PAPER 86-044] p 99 A87-32745 System architecture for the telerobotic work system [AAS PAPER 86-044] p 167 A87-33019 Dynamic and attitude control characteristics of an International Space Station [AIAA PAPER 87-0931] p 57 A87-33731 Manned spacecraft electrical power systems p 75 A87-37291 Space Station data management system architecture p 111 A87-37293 Space station data management system - A common	Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125 Development of a prototype two-phase thermal bus system for Space Station [AIAA PAPER 87-1628] p 44 A87-43126 Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger [AIAA PAPER 87-1540] p 44 A87-44843 FDMA system design and analysis for Space Station p 85 A87-45483 Space Station multiple access communications system p 86 A87-45524 Man's role in space exploration and exploitation p 169 A87-46332 Space Station Information System integrated communications concept [AIAA PAPER 87-2228] p 114 A87-48606 Space Station Information System requirements for integrated communications [AIAA PAPER 87-2229] p 114 A87-48607 Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Proposed CMG momentum management scheme for space station [AIAA PAPER 87-2528] p 62 A87-50531 Space station control moment gyro control p 64 N87-20669 Aero-Assisted Orbital Transfer Vehicle (AOTV) p 3 N87-20682 Microgravity fluid management in two-phase thermal systems p 95 N87-21152 Track and capture of the orbiter with the space station remote manipulator system	Effects of local vibrations on the dynamics of space truss structures  [AIAA PAPER 87-0941] p 17 A87-33739  Thermal design of the ACCESS erectable space truss p 42 A87-34469  Composite tubes for the Space Station truss structure p 20 A87-38601  Assessment of space environment induced microdamage in toughened composite materials  p 20 A87-38609  Effects of varying environmental parameters on trace contaminant concentrations in the NASA Space Station Reference Configuration  [SAE PAPER 860916] p 47 A87-38708  Supercritical water oxidation - Concept analysis for evolutionary Space Station application  [SAE PAPER 860993] p 51 A87-38770  Evaluation of Space Station thermal control techniques  [SAE PAPER 860998] p 42 A87-38775  Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Dynamic analysis and experiment methods for a generic space station model p 22 A87-41613  Interdisciplinary analysis procedures in the modeling and control of large space-based structures  p 22 A87-42678  Effects of atmosphere on slewing control of a flexible structure  Robust eigensystem assignment for flexible structures  [AIAA PAPER 87-2252] p 23 A87-50416  Single-mode projection filters for identification and state estimation of flexible structures  [AIAA PAPER 87-2387] p 24 A87-50471
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-29916 National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla. Quick-disconnect inflatable seal assembly [NASA-CASE-KSC-11368-1] p 102 N87-29168 KSC Space Station Operations Language (SSOL) p 138 N87-29168 National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. Space Station integration and verification concepts p 84 A87-31461 Selected materials issues associated with Space Station Role of the manned maneuvering unit for the Space Station [SAE PAPER 861834] p 193 A87-32061 Role of the manned maneuvering unit for the Space Station [SAE PAPER 861834] p 133 A87-32667 System level verification applying the Space Shuttle experience to the Space Station [AAS PAPER 86-043] p 99 A87-3277 Laser docking system flight experiment [AAS PAPER 86-043] p 99 A87-32745 System architecture for the telerobotic work system [AAS PAPER 86-044] p 167 A87-33019 Dynamic and attitude control characteristics of an International Space Station [AIAA PAPER 87-0931] p 57 A87-33731 Manned space flight p 167 A87-33731 Manned space can be supposed by the system architecture p 111 A67-37293 Space Station data management system architecture p 111 A67-37293 Space station data management system architecture p 111 A67-37294	Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125 Development of a prototype two-phase thermal bus system for Space Station [AIAA PAPER 87-1628] p 44 A87-43126 Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger [AIAA PAPER 87-1540] p 44 A87-44843 FDMA system design and analysis for Space Station p 85 A87-45483 Space Station multiple access communications system p 86 A87-45524 Man's role in space exploration and exploitation p 169 A87-46332 Space Station Information System integrated communications concept [AIAA PAPER 87-2228] p 114 A87-48606 Space Station Information System requirements for integrated communications [AIAA PAPER 87-2228] p 114 A87-48607 Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Proposed CMG momentum management scheme for space station [AIAA PAPER 87-2528] p 62 A87-50531 Space station control moment gyro control p 64 N87-20669 Aero-Assisted Orbital Transfer Vehicle (AOTV) p 3 N87-20682 Microgravity fluid management in two-phase thermal systems p 95 N87-21152 Track and capture of the orbiter with the space station remote manipulator system	Effects of local vibrations on the dynamics of space truss structures  [AIAA PAPER 87-0941] p 17 A87-33739  Thermal design of the ACCESS erectable space truss p 42 A87-34469  Composite tubes for the Space Station truss structure p 20 A87-38601  Assessment of space environment induced microdamage in toughened composite materials p 20 A87-38609  Effects of varying environmental parameters on trace contaminant concentrations in the NASA Space Station Reference Configuration  [SAE PAPER 860916] p 47 A87-38708  Supercritical water oxidation - Concept analysis for evolutionary Space Station application  [SAE PAPER 860993] p 51 A87-38770  Evaluation of Space Station thermal control techniques  [SAE PAPER 860998] p 42 A87-38775  Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Dynamic analysis and experiment methods for a generic space station model p 22 A87-41613  Interdisciplinary analysis procedures in the modeling and control of large space-based structures  P 22 A87-47809  Robust eigensystem assignment for flexible structure  Robust eigensystem assignment for flexible structures  [AIAA PAPER 87-2252] p 23 A87-50416  Single-mode projection filters for identification and state estimation of flexible structures  [AIAA PAPER 87-2387] p 24 A87-50416
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-29916 National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla. Quick-disconnect inflatable seal assembly [NASA-CASE-KSC-11368-1] p 102 N87-25583 KSC Space Station Operations Language (SSOL) p 138 N87-29168 National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. Space Station integration and verification concepts p 84 A87-31461 Selected materials issues associated with Space Station p 105 A87-32061 Role of the manned maneuvering unit for the Space Station [SAE PAPER 861834] p 133 A87-32667 System level verification applying the Space Shuttle experience to the Space Station [AAS PAPER 86-001] p 55 A87-32727 Laser docking system flight experiment [AAS PAPER 86-043] p 99 A87-32745 System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32745 Manned space flight p 167 A87-33019 Dynamic and attitude control characteristics of an International Space Station [AIAA PAPER 87-0931] p 57 A87-33731 Manned spacecraft electrical power systems p 75 A87-37291 Space Station data management system architecture p 111 A87-37293 Space station data management system - A common GSE test interface for systems testing and verification p 112 A87-37294 Shuttle orbit flight control design lessons - Direction for	Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125 Development of a prototype two-phase thermal bus system for Space Station [AIAA PAPER 87-1628] p 44 A87-43126 Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger [AIAA PAPER 87-1540] p 44 A87-44843 FDMA system design and analysis for Space Station p 85 A87-45483 Space Station multiple access communications system p 86 A87-45524 Man's role in space exploration and exploitation p 169 A87-4532 Space Station Information System integrated communications concept [AIAA PAPER 87-2228] p 114 A87-48606 Space Station Information System requirements for integrated communications [AIAA PAPER 87-2229] p 114 A87-48607 Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Proposed CMG momentum management scheme for space station [AIAA PAPER 87-2528] p 62 A87-50531 Space station control moment gyro control p 64 N87-20669 Aero-Assisted Orbital Transfer Vehicle (AOTV) p 3 N87-20669 Microgravity fluid management in two-phase thermal systems p 95 N87-21152 Track and capture of the orbiter with the space station remote manipulator system [NASA-TM-89221] p 137 N87-25339 Collect lock joint for space station truss	Effects of local vibrations on the dynamics of space truss structures  [AIAA PAPER 87-0941] p 17 A87-33739  Thermal design of the ACCESS erectable space truss p 42 A87-34469  Composite tubes for the Space Station truss structure p 20 A87-38601  Assessment of space environment induced microdamage in toughened composite materials p 20 A87-38609  Effects of varying environmental parameters on trace contaminant concentrations in the NASA Space Station Reference Configuration  [SAE PAPER 860916] p 47 A87-38708  Supercritical water oxidation - Concept analysis for evolutionary Space Station application  [SAE PAPER 860993] p 51 A87-38770  Evaluation of Space Station thermal control techniques  [SAE PAPER 860998] p 42 A87-38775  Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Dynamic analysis and experiment methods for a generic space station model p 22 A87-41613  Interdisciplinary analysis procedures in the modeling and control of large space-based structures  [P 22 A87-42678  Effects of atmosphere on slewing control of a flexible structure  [P 22 A87-47809  Robust eigensystem assignment for flexible structures  [AIAA PAPER 87-2252] p 23 A87-50416  Single-mode projection filters for identification and state estimation of flexible structures  [AIAA PAPER 87-2387] p 24 A87-50471  On-line identification and attitude control of SCOLE  [AIAA PAPER 87-2459] p 61 A87-50505
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-29916  National Aeronautics and Space Administration. John  F. Kennedy Space Center, Cocoa Beach, Fia.  Quick-disconnect inflatable seal assembly  [NASA-CASE-KSC-11368-1] p 102 N87-25583 KSC Space Station Operations Language (SSCL) p 138 N87-29168  National Aeronautics and Space Administration.  Lyndon B. Johnson Space Center, Houston, Tex.  Space Station integration and verification concepts p 84 A87-31461  Selected materials issues associated with Space Station p 105 A87-32061  Role of the manned maneuvering unit for the Space Station  [SAE PAPER 861834] p 133 A87-32667  System level verification applying the Space Shuttle experience to the Space Station  [AAS PAPER 86-001] p 55 A87-32727  Laser docking system flight experiment  [AAS PAPER 86-043] p 99 A87-32745  System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32745  Manned space flight p 167 A87-33019  Dynamic and attitude control characteristics of an International Space Station  [AIAA PAPER 87-0931] p 57 A87-33731  Manned spacecraft electrical power systems p 75 A87-37291  Space Station data management system architecture p 111 A87-37293  Space station data management system architecture p 111 A87-37293  Space station data management system architecture p 111 A87-37293  Space Station data management system - A common GSE test interface for systems testing and verification p 188-372991  Shuttle orbit flight control design lessons - Direction for Space Station	Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125 Development of a prototype two-phase thermal bus system for Space Station [AIAA PAPER 87-1628] p 44 A87-43126 Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger [AIAA PAPER 87-1540] p 44 A87-44843 FDMA system design and analysis for Space Station p 85 A87-45483 Space Station multiple access communications system p 86 A87-45524 Man's role in space exploration and exploitation p 169 A87-46332 Space Station Information System integrated communications concept [AIAA PAPER 87-2228] p 114 A87-48606 Space Station Information System requirements for integrated communications [AIAA PAPER 87-2229] p 114 A87-48607 Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Proposed CMG momentum management scheme for space station [AIAA PAPER 87-2528] p 62 A87-50531 Space station control moment gyro control p 64 N87-20669 Aero-Assisted Orbital Transfer Vehicle (AOTV) p 3 N87-20669 Aero-Assisted Orbital Transfer Vehicle (AOTV) Track and capture of the orbiter with the space station remote manipulator system [NASA-TM-89221] p 137 N87-25339 Collect lock joint for space station truss [NASA-CASE-MSC-21207-1] p 36 N87-25576	Effects of local vibrations on the dynamics of space truss structures  [AIAA PAPER 87-0941] p 17 A87-33739  Thermal design of the ACCESS erectable space truss p 42 A87-34469  Composite tubes for the Space Station truss structure p 20 A87-38601  Assessment of space environment induced microdamage in toughened composite materials p 20 A87-38609  Effects of varying environmental parameters on trace contaminant concentrations in the NASA Space Station Reference Configuration  [SAE PAPER 860916] p 47 A87-38708  Supercritical water oxidation - Concept analysis for evolutionary Space Station application  [SAE PAPER 860993] p 51 A87-38770  Evaluation of Space Station thermal control techniques  [SAE PAPER 860998] p 42 A87-38775  Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Dynamic analysis and experiment methods for a generic space station model p 22 A87-41613  Interdisciplinary analysis procedures in the modeling and control of large space-based structures  [AIAA PAPER 87-2252] p 23 A87-50416  Single-mode projection filters for identification and state estimation of flexible structures  [AIAA PAPER 87-2387] p 24 A87-50471  On-line identification and attitude control for SCOLE  Distributed parameter modelling of the structural
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-29916 National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla. Quick-disconnect inflatable seal assembly [NASA-CASE-KSC-11368-1] p 102 N87-29168 KSC Space Station Operations Language (SSOL) p 138 N87-29168 National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex. Space Station integration and verification concepts p 84 A87-31461 Selected materials issues associated with Space Station p 105 A87-32061 Role of the manned maneuvering unit for the Space Station [SAE PAPER 861834] p 133 A87-32667 System level verification applying the Space Shuttle experience to the Space Station [AAS PAPER 86-043] p 99 A87-32745 System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32746 Manned space flight p 167 A87-33019 Dynamic and attitude control characteristics of an International Space Station [AIAA PAPER 87-0931] p 57 A87-33731 Manned space craft electrical power systems p 75 A87-37291 Space Station data management system architecture p 111 A87-37293 Space station data management system architecture p 111 A87-37294 Shuttle orbit flight control design lessons - Direction for Space Station communications and tracking system	Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125 Development of a prototype two-phase thermal bus system for Space Station [AIAA PAPER 87-1628] p 44 A87-43126 Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger [AIAA PAPER 87-1540] p 44 A87-44843 FDMA system design and analysis for Space Station p 85 A87-45483 Space Station multiple access communications system p 86 A87-45524 Man's role in space exploration and exploitation p 169 A87-4532 Space Station Information System integrated communications concept [AIAA PAPER 87-2228] p 114 A87-48606 Space Station Information System requirements for integrated communications [AIAA PAPER 87-2229] p 114 A87-48607 Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Proposed CMG momentum management scheme for space station [AIAA PAPER 87-2528] p 62 A87-50531 Space station control moment gyro control p 64 N87-20669 Aero-Assisted Orbital Transfer Vehicle (AOTV) p 3 N87-20669 Microgravity fluid management in two-phase thermal systems p 95 N87-21152 Track and capture of the orbiter with the space station remote manipulator system [NASA-TM-89221] p 137 N87-25339 Collect lock joint for space station truss	Effects of local vibrations on the dynamics of space truss structures  [AIAA PAPER 87-0941] p 17 A87-33739  Thermal design of the ACCESS erectable space truss p 42 A87-34469  Composite tubes for the Space Station truss structure p 20 A87-38601  Assessment of space environment induced microdamage in toughened composite materials p 20 A87-38609  Effects of varying environmental parameters on trace contaminant concentrations in the NASA Space Station Reference Configuration  [SAE PAPER 860916] p 47 A87-38708  Supercritical water oxidation - Concept analysis for evolutionary Space Station application  [SAE PAPER 860993] p 51 A87-38770  Evaluation of Space Station thermal control techniques  [SAE PAPER 860998] p 42 A87-38775  Experiences with the Lanczos method on a parallel computer p 21 A87-41159  Dynamic analysis and experiment methods for a generic space station model p 22 A87-41613  Interdisciplinary analysis procedures in the modeling and control of large space-based structures  [P 22 A87-42678  Effects of atmosphere on slewing control of a flexible structure  [P 22 A87-47809  Robust eigensystem assignment for flexible structures  [AIAA PAPER 87-2252] p 23 A87-50416  Single-mode projection filters for identification and state estimation of flexible structures  [AIAA PAPER 87-2387] p 24 A87-50471  On-line identification and attitude control for SCOLE  [AIAA PAPER 87-2459] p 61 A87-50505  Distributed parameter modeling of the structural dynamics of the Solar Array Flight Experiment  [AIAA PAPER 87-2460] p 25 A87-50506
Network operating system p 117 N87-29166 LEO and GEO missions p 5 N87-29916  National Aeronautics and Space Administration. John  F. Kennedy Space Center, Cocoa Beach, Fia.  Quick-disconnect inflatable seal assembly  [NASA-CASE-KSC-11368-1] p 102 N87-25583 KSC Space Station Operations Language (SSCL) p 138 N87-29168  National Aeronautics and Space Administration.  Lyndon B. Johnson Space Center, Houston, Tex.  Space Station integration and verification concepts p 84 A87-31461  Selected materials issues associated with Space Station p 105 A87-32061  Role of the manned maneuvering unit for the Space Station  [SAE PAPER 861834] p 133 A87-32667  System level verification applying the Space Shuttle experience to the Space Station  [AAS PAPER 86-001] p 55 A87-32727  Laser docking system flight experiment  [AAS PAPER 86-043] p 99 A87-32745  System architecture for the telerobotic work system [AAS PAPER 86-044] p 99 A87-32745  Manned space flight p 167 A87-33019  Dynamic and attitude control characteristics of an International Space Station  [AIAA PAPER 87-0931] p 57 A87-33731  Manned spacecraft electrical power systems p 75 A87-37291  Space Station data management system architecture p 111 A87-37293  Space station data management system architecture p 111 A87-37293  Space station data management system architecture p 111 A87-37293  Space Station data management system - A common GSE test interface for systems testing and verification p 188-372991  Shuttle orbit flight control design lessons - Direction for Space Station	Thermal test results of the two-phase thermal bus technology demonstration loop [AIAA PAPER 87-1627] p 44 A87-43125 Development of a prototype two-phase thermal bus system for Space Station [AIAA PAPER 87-1628] p 44 A87-43126 Structural and preliminary thermal performance testing of a pressure activated contact heat exchanger [AIAA PAPER 87-1540] p 44 A87-44843 FDMA system design and analysis for Space Station p 85 A87-45483 Space Station multiple access communications system p 86 A87-45524 Man's role in space exploration and exploitation p 169 A87-46332 Space Station Information System integrated communications concept [AIAA PAPER 87-2228] p 114 A87-48606 Space Station Information System requirements for integrated communications [AIAA PAPER 87-2229] p 114 A87-48607 Radiation environments and absorbed dose estimations on manned space missions p 139 A87-49026 Proposed CMG momentum management scheme for space station [AIAA PAPER 87-2528] p 62 A87-50531 Space station control moment gyro control p 64 N87-20669 Aero-Assisted Orbital Transfer Vehicle (AOTV) p 3 N87-20682 Microgravity fluid management in two-phase thermal systems p 95 N87-21152 Track and capture of the orbiter with the space station remote manipulator system [NASA-TM-89221] p 137 N87-25339 Collect lock joint for space station truss [NASA-CASE-MSC-21207-1] p 36 N87-25576 Preloadable vector sensitive latch	Effects of local vibrations on the dynamics of space truss structures [AIAA PAPER 87-0941] p 17 A87-33739 Thermal design of the ACCESS erectable space truss p 42 A87-34469 Composite tubes for the Space Station truss structure p 20 A87-38601 Assessment of space environment induced microdamage in toughened composite materials p 20 A87-38609 Effects of varying environmental parameters on trace contaminant concentrations in the NASA Space Station Reference Configuration [SAE PAPER 860916] p 47 A87-38708 Supercritical water oxidation - Concept analysis for evolutionary Space Station application [SAE PAPER 860993] p 51 A87-38770 Evaluation of Space Station thermal control techniques [SAE PAPER 860998] p 42 A87-38775 Experiences with the Lanczos method on a parallel computer p 21 A87-41159 Dynamic analysis and experiment methods for a generic space station model p 22 A87-41613 Interdisciplinary analysis procedures in the modeling and control of large space-based structures  [Fefects of atmosphere on slewing control of a flexible structure [AIAA PAPER 87-2252] p 23 A87-50416 Single-mode projection filters for identification and state estimation of flexible structures [AIAA PAPER 87-2252] p 24 A87-50416 Single-mode projection filters for identification and state estimation of flexible structures [AIAA PAPER 87-2252] p 24 A87-50416 Distributed parameter modeling of the structural dynamics of the Solar Array Flight Experiment

```
A simulation model for the analysis of Space Station
                                                                   Hollow cathode-based plasma contactor experiments for
     gas-phase trace contaminants
                                        p 52 A87-53979
                                                                 electrodynamic tether
      Effects of space plasma discharge on the performance
                                                                 [AIAA PAPER 87-0572]
    of large antenna structures in low Earth orbit [NASA-TM-89118] p 86
                                                                   Advanced technology for extended endurance alkaline
                                        p 86 N87-20339
      Large space antennas: A systems analysis case
                                                                   Space Station 20-kHz power
                                                                 distribution system
    [NASA-TM-890721
                                         p 26 N87-20352
                                                                   Manned spacecraft electrical power systems
      Modeling of joints for the dynamic analysis of truss
                                                                   Composite space antenna structures - Properties and
    [NASA-TP-2661]
                                         p 28 N87-20567
                                                                 environmental effects
      Documentation of the space station/aircraft acoustic
                                                                   20 kHz Space Station power system
    INASA-TM-891111
                                        p 140 N87-20795
      Analysis of on-orbit thermal characteristics of the
                                                                   Resistojet control and power for high frequency ac
     15-meter hoop/column antenna
    [NASA-TM-89137]
                                                                 [AIAA PAPER 87-0994]
                                        p 45 N87-21021
      Measurement apparatus and procedure for the
                                                                   Liquid sheet radiator
    determination of surface emissivities
                                                                 [AIAA PAPER 87-1525]
    [NASA-CASE-LAR-13455-1]
                                        p 29 N87-21206
                                                                   Liquid droplet radiator development status
      Status of the Mast experiment
                                         p 30 N87-22703
                                                                 [AIAA PAPER 87-1537]
                                                                                                     p 43
      Microprocessor controlled proof-mass actuator
                                                                   An advanced geostationary communications platform
                                        p 65 N87-22706
      Considerations in the design and development of a
                                                                  Conceptual design and integration of a Space Station
    space station scale model
                                         p.9 N87-22711
                                                                 resistojet propulsion assembly
      Status report and preliminary results of the spacecraft
                                                                [AIAA PAPER 87-1860]
                                        p 66 N87-22717
    control laboratory experiment
                                                                  Thermodynamic analysis and subscale modeling of
      An overview of controls research on the NASA Langley
                                                                space-based orbit transfer vehicle cryogenic propellant
    Research Center grid
                                        p 66 N87-22720
     Control of flexible structures and the research
                                                                [AIAA PAPER 87-1764]
                                        p 66 N87-22732
                                                                  Preliminary performance characterizations of an
     Dual keel space station control/structures interaction
                                                                engineering model multipropellant resistojet for space
   study
                                        p 67 N87-22737
                                                                station application
     Slewing control experiment for a flexible panel p 78 N87-22740
                                                                [AIAA PAPER 87-2120]
                                                                  Temperature fields due to jet induced mixing in a typical
     Optimization of payload mass placement in a dual keel
                                                                ∩TV tank
    space station
                                                                [AIAA PAPER 87-2017]
   [NASA-TM-89051]
                                        p 68 N87-23687
                                                                  Effect of nozzle geometry on the resistojet exhaust
     NASA/DOD Control/Structures Interaction Technology,
                                                                [AIAA PAPER 87-2121]
   [NASA-CP-2447-PT-2]
                                        p 34 N87-24495
                                                                  Fire safety concerns in space operations
     Design, construction and utilization of a space station
                                                                INASA-TM-898481
   assembled from 5-meter erectable struts
                                                                  Liquid droplet radiator development status
                                       р 34
                                              N87-24501
                                                                [NASA-TM-89852]
     Controls-structures-electromagnetics
                                               interaction
                                                                  Conceptual design and integration of a space station
   program
                                       p 69 N87-24502
                                                                resistojet propulsion assembly
     Hoop/column and tetrahedral truss electromagnetic
                                                               [NASA-TM-89847]
   tests
                                       p 87
                                                                 Resistojet control and power for high frequency ac
     COFS 3 multibody dynamics and control technology
p 69 N87-24506
                                                               buses
                                                               [NASA-TM-89860]
     Slew maneuvers on the SCOLE Laboratory Facility
                                                               Microgravity Fluid Management Symposium [NASA-CP-2465] p 94
                                       p 69 N87-24511
     Research in slewing and tracking control
                                                                 Cryogenic Fluid Management Flight
                                       p 70
                                             N87-24512
     Deployable geodesic truss structure
                                                                 Space station electric power system requirements and
   [NASA-CASE-LAR-13113-1]
                                       p 36 N87-25492
     Vapor fragrancer
                                                               [NAŠA-TM-89889]
   [NASA-CASE-LAR-13680-1]
                                      p 165 N87-25561
                                                                 Coaxial tube
                                                                                 array space
     Experimental evaluation of small-scale erectable truss
                                                               characterization
   hardware
                                                               [NASA-TM-898641
   [NASA-TM-89068]
                                       p 37 N87-26085
                                                                 EMC and power quality standards for 20-kHz power
    Preloaded space structural coupling joints
   [NASA-CASE-LAR-13489-1]
                                       p 38 N87-27713
                                                               [NASA-TM-89925]
   Mobile remote manipulator vehicle [NASA-CASE-LAR-13393-1]
                                                                 Selection of high temperature thermal energy storage
                                     p 103 N87-29118
                                                               materials for advanced solar dynamic space power
    Distributed computer taxonomy
                                       based on O/S
                                                               systems
                                                               [NASA-TM-898861
                                     p 116 N87-29127
                                                                 A 2000-hour cyclic endurance test of a laboratory model
    A workstation environment for software engineering
                                                               multipropellant resistojet
                                     p 116 N87-29128
                                                               [NASA-TM-89854]
    Engineering graphics and image processing at Langley
                                                                 Thermodynamic analysis and subscale modeling of
  Research Center
                                      p 10
                                            N87-29129
                                                               space-based orbit transfer vehicle cryogenic propellant
    A VHSIC general purpose processor
                                                               resupply
                                     p 116 N87-29145
                                                               [NASA-TM-89921]
    Information network architectures
                                     p 116 N87-29149
                                                                Performance characteristics of a combination solar
    Video image processing
                                     p 116 N87-29150
                                                               photovoltaic heat engine energy converter
    Fiber
                                                               [NASA-TM-89908]
                optics
                                     ngth
                                                division
   multiplexing(components)
                                                                Speculations on future opportunities to evolve Brayton
                                     p 117
                                            N87-29151
                                                               powerplants aboard the space station
    Fiber optics common transceiver module
                                            N87-29160
                                     p 117
                                                               [NASA-TM-898631
    Electronic control/display interface technology
                                                                Control considerations for high frequency, resonant,
                                                               power processing equipment used in large systems
                                      p 88 N87-29161
                                                              [NASA-TM-89926]
    Technology for Large Space Systems. A bibliography
                                                                Oxidation protection coatings for polymers
   vith indexes (supplement 17)
                                                              [NASA-CASE-LEW-14072-3]
  [NASA-SP-7046(17)]
                                      p 39 N87-29576
                                                                Preliminary performance characterizations of an
    Space Station end effector strategy study
                                                              engineering model multipropellant resistojet for space
  [NASA-TM-100488]
                                    p 103 N87-29593
                                                              station application
   A spline-based parameter and state
                                           estimation
                                                              [NASA-TM-100113]
  technique for static models of elastic surfaces
                                                                Resistojet plume and induced environment analysis
 [NASA-CR-180449]
                                     p 11 N87-30107
                                                              [NASA-TM-889571
National Aeronautics and Space Administration. Lewis
                                                                Effect of component compression on the initial
  Research Center, Cleveland, Ohio.
                                                              performance of an IPV nickel-hydrogen cell
   The effect of circumferential aerodynamic detuning on
```

coupled bending-torsion unstalled supersonic flutter

p 166 A87-25396

[ASME PAPER 86-GT-100]

```
An evaluation of candidate oxidation resistant materials
                                                              for space applications in LEO
                                     p 121 A87-32192
                                                              [NASA-TM-100122]
                                                                                                p 107 N87-25480
                                                                Nuclear reactor power for a space-based radar. SP-100
                                      p 75 A87-33787
                                                              project
                                                              [NASA-TM-89295]
                                     management and
                                                                                                  p 79 N87-25838
                                                                Proven, long-life hydrogen/oxygen thrust chambers for
                                      p 75 A87-36913
                                                                                                 p 98 N87-26133
                                                              space station propulsion
                                                                Water-propellant resistojets for man-tended platforms
                                      p 75 A87-37291
                                                              [NASA-TM-100110]
                                                                                                 p 98 N87-26135
                                                                Space station electrical power system
                                     p 20 A87-38610
                                                              [NASA-TM-100140]
                                                                                                 p 80 N87-26144
                                                               Neutral atomic oxygen beam produced by ion charge
                                      p 76 A87-40378
                                                              exchange for Low Earth Orbital (LEO) simulation
                                                                                                p 131 N87-26188
                                                                An evaluation of candidate
                                                                                               oxidation resistant
                                      p 58 A87-41103
                                                              materials
                                                                                                p 110 N87-26203
                                                                Space station power system
                                                                                                 p 80 N87-26447
                                     p 43 A87-43048
                                                                Electrodynamic tether
                                                                                                p 131 N87-26449
                                                                High power/large area PV systems
                                                                                                 p 80 N87-26452
                                                                The space station power system
                                                                                                 p 81 N87-28960
                                    p 125 A87-43165
                                                               Alternative power generation concepts for space
                                                               p 81 N87-28961
Space Electrochemical Research and Technology
                                     p 91 A87-45256
                                                             (SERT)
                                                             [NASA-CP-2484]
                                                                                                  p 5 N87-29914
                                                               Status of space station power system
                                                                                                p 84 N87-29915
                                                            National Aeronautics and Space Administration.
                                     p 92 A87-48572
                                                             Marshall Space Flight Center, Huntsville, Ala.
                                                               A space debris simulation facility for spacecraft materials
                                                                                                 p 11 A87-32058
                                                               National space transportation studies
                                     p 93 A87-50197
                                                             [SAE PAPER 861681]
                                                                                               p 160 A87-32598
                                                               Prototype thermal bus for manned Space Station
                                     p 93 A87-52247
                                                             [SAE PAPER 861825]
                                                               Use of the Orbital Maneuvering Vehicle (OMV) for
                                     p 62 A87-52252
                                                             placement and retrieval of spacecraft and platforms
                                                             [AAS PAPER 86-041]
                                                                                               p 133 A87-32743
                                   p 165 N87-20342
                                                               Solar array flight dynamic experiment
                                                             [AAS PAPER 86-050]
                                                                                                p 75 A87-32747
                                                               Potential modulation on the SCATHA spacecraft
                                     p 44 N87-20353
                                                                                               p 138 A87-34460
                                                               Space Station environmental control and life support
                                                             system distribution and loop closure studies
                                     p 93 N87-20378
                                                            [SAE PAPER 860942]
                                                                                                p 48 A87-38729
                                                               Status of the Space Station environmental control and
                                     p 63 N87-20477
                                                            life support system design concept [SAE PAPER 860943]
                                                                                                p 48 A87-38730
                                     p 94 N87-21141
                                                              Air Evaporation closed cycle water recovery technology
                                    Flight Experiment
p 95 N87-21150
                                                              Advanced energy saving designs
                                                            [SAE PAPER 860987]
                                                                                                p 51 A87-38766
                                                              Advanced orbital servicing capabilities development
                                                            [SAE PAPER 860992]
                                                                                              p 134 A87-38769
                                    p 96 N87-22001
                                                              Maintenance components for Space Station long life
                                                            fluid systems
                                   transmission line
                                                            [SAE PAPER 861005]
                                                                                                p 89 A87-38778
                                    p 96 N87-22003
                                                              Evaluation of cryogenic system test options for the OTV
                                                            on-orbit propellant depot
                                                            [AIAA PAPER 87-1498]
                                                                                                p 90 A87-43027
                                                              Space Station propulsion system test bed and control
                                    p 78 N87-22004
                                                               stem testing results
                                                            [AIAA PAPER 87-1858]
                                                                                                p 91 A87-45255
                                                              Adaptive momentum management for the dual keel
                                                            Space Station
                                    p 78 N87-22174
                                                            [AIAA PAPER 87-2596]
                                                                                                p 62 A87-50558
                                                              Solar array flight experiment/dynamic augmentation
                                    p 96 N87-22237
                                                            [NASA-TP-2690]
                                                                                               p 63 N87-20380
                                                              Space station structures and dynamics test program
                                                            [NASA-TP-2710]
                                                                                               p 28 N87-20568
                                                              SAFE/DAE: Modal test in space
                                   p 96 N87-22949
                                                                                               p 77 N87-20584
                                                              Upper and Middle Atmospheric Density Modeling
                                                            Requirements for Spacecraft Design and Operations
                                   p 78 N87-23028
                                                            [NASA-CP-2460]
                                                                                              p 64 N87-20665
                                                              Space station momentum management
                                                                                              p 64 N87-20668
                                  p 121 N87-23674
                                                             Advanced long term cryogenic storage systems
                                                                                               p 94 N87-21142
                                                             Equations of motion of a space station with emphasis
                                   p 68 N87-23690
                                                            on the effects of the gravity gradient
                                                           [NASA-TM-86588]
                                                                                               p 64 N87-21993
                                  p 107 N87-23736
                                                             Structural Dynamics and Control Interaction of Flexible
                                                           Structures
                                                           [NASA-CP-2467-PT-1]
                                                                                              p 65 N87-22702
                                                             Large space structures ground experiment checkout
                                   p 96 N87-23821
                                                                                              p 30 N87-22704
                                                             Commit your works to the Lord, and your thoughts shall
                                                           be established (Prov. 16:3). Inter-stable control systems
                                   p 96 N87-24536
                                                                                               p 9 N87-22716
                                                             Solar array flight dynamic experiment
[NASA-TM-100102]
                                   p 79 N87-24838
                                                                                              p 78 N87-22722
  Space station propulsion system technology
                                                             Dynamic characteristics of a vibrating beam with periodic
[NASA-TM-100108]
                                        N87-25422
                                   p 97
                                                           variation in bending stiffness
                                                                                              p 32 N87-22726
```

Rockwell International Corp., Canoga Park, Calif.

Workshop on Structural Dynamics and Control Interaction of Flexible Structures p 32 N87-22728	Ohio State Univ., Columbus. Progress on the Ohio State University Get Away Special	Rockwell International Corp., Canoga Park, Calif. Concepts for space maintenance of OTV engines
Interaction of Flexible Structures p 32 N87-22728 Structural Dynamics and Control Interaction of Flexible	G-0318: DEAP p 170 N87-20311	p 135 A87-41161
Structures	Variable structure control system maneuvering of spacecraft p 64 N87-21989	Space Station propulsion system test bed and control system testing results
[NASA-CP-2467-PT-2] p 66 N87-22729	Old Dominion Univ., Norfolk, Va.	[ÁIAA PAPER 87-1858] p 91 A87-45255
A TREETOPS simulation of the Hubble Space Telescope-High Gain Antenna interaction p 9 N87-22735	Robust controller synthesis for a large flexible space antenna p 84 A87-32235	Concepts for space maintenance of OTV engines p 136 A87-46000
System identification for large space structure damage	Practical implementation of an accurate method for multilevel design sensitivity analysis	Density uncertainty effect on cost of space station repost p 170 N87-20667
assessment p 33 N87-22750	[AIAA PAPER 87-0718] p 6 A87-33560	reboost p 170 N87-20667 Space station WP-04 power system. Volume 1:
Space station structures and dynamics test program p 33 N87-22751	Single-mode projection filters for identification and state estimation of flexible structures	Executive summary
Large space structures testing	[AIAA PAPER 87-2387] p 24 A87-50471	[NASA-CR-179587-VOL-1] p 78 N87-23695 Space station WP-04 power system. Volume 2: Study
[NASA-TM-100306] p 35 N87-24520	Projection filters for modal parameter estimate for	results
Distributed control using linear momentum exchange	flexible structures [NASA-CR-180303] p 38 N87-26583	[NASA-CR-179587-VOL-2] p 79 N87-23696
devices [NASA-TM-100308] p 70 N87-24521	Substructure analysis using NICE/SPAR and	Concepts for space maintenance of OTV engines p 137 N87-26097
Characterization and hardware modification of linear	applications of force to linear and nonlinear structures [NASA-CR-180317] p 38 N87-27260	Hydrogen/oxygen economy for the space station
momentum exchange devices [NASA-TM-86594] p 70 N87-24723	[NASA-CR-180317] p 38 N87-27260 Open Univ., Oxford (England).	p 98 N87-26130
[NASA-TM-86594] p /0 N87-24723 Bi-stem gripping apparatus	Ideas for educational physics experiments in space	Rockwell International Corp., Downey, Calif.
[NASA-CASE-MFS-28185-1] p 107 N87-25586	p 130 N87-25033 Operations Research, Inc., Silver Spring, Md.	Structural/control interaction (payload pointing and micro-g) p 9 N87-22721
Space station propulsion test bed: A complete system p 98 N87-26131	Servicing of user payload equipment in the Space Station	Preliminary evaluation of a reaction control system for
A 25-LBF gaseous oxygen/gaseous hydrogen thruster	pressurized environment	the space station p 67 N87-22736
for space station application p 98 N87-26132	[SAE PAPER 860973] p 134 A87-38/55	The design and development of a mobile transporter system for the Space Station Remote Manipulator
NASA Marshall Space Flight Center atomic oxygen	P	System p 104 N87-29865
investigations p 109 N87-26202  National Aeronautics and Space Administration.	•	Space Station based options for orbiter
Pasadena Office, Calif.	Perkin-Elmer Corp., Danbury, Conn.	docking/berthing p 138 N87-29877  Rockwell International Corp., Houston, Tex.
Variable energy, high flux, ground-state atomic oxygen	Optical arrays for future astronomical telescopes in space p 126 A87-44533	Radiation environments and absorbed dose estimations
source [NASA-CASE-NPO-16640-1-CU] p 8 N87-21661	Physical Sciences, Inc., Andover, Mass.	on manned space missions p 139 A87-49026
National Bureau of Standards, Gaithersburg, Md.	A high flux pulsed source of energetic atomic oxygen p 139 A87-38623	Rome Air Development Center, Hanscom AFB, Mass.  Spacecraft dielectric material properties and spacecraft
Kinetics and mechanisms of some atomic oxygen	Pulsed source of energetic atomic oxygen	charging p 105 A87-33100
reactions p 141 N87-20179  National Center for Atmospheric Research, Boulder,	p 108 N87-26189	Rome Univ. (Italy).
Colo.	Chemical interactions in Low Earth Orbit (LEO) p 109 N87-26198	Effect of modal damping in modal synthesis of spacecraft structures p 26 N87-20362
A crisis in the NASA space and earth sciences programme p 112 A87-37968	Physikalisch-Technische Bundesanstalt, Brunswick	Sampled nonlinear control for large angle maneuvers
programme p 112 A87-37968  National Oceanic and Atmospheric Administration,	(West Germany).	of flexible spacecraft p 71 N87-25358
Washington, D. C.	Absolute indoor calibration of large area solar cells p 159 N87-29015	Royal Aircraft Establishment, Farnborough (England). The use of Pi2 pulsations as indicators of substorm
Planning for future operational sensors and other	Politecnico di Milano (Italy).	effects at geostationary orbit p 142 N87-26942
priorities [NOAA-NESDIS-30] p 130 N87-25560	Active structural controllers emulating structural	Royal Netherlands Aircraft Factories Fokker,
Naval Postgraduate School, Monterey, Calif.	elements by ICUs p 27 N87-20367  Automatic docking maneuver and attitude control s	Amsterdam.  End effector development study. Volume 2: Service End
The effect of multipath on digital communications systems: With application to space station	ystem p 71 N87-25395	Effector subsystem specification (SEESSPEC)
[AD-A178578] p 86 N87-22876	Prairie View Agricultural and Mechanical Coll., Tex.	[FOK-TR-R-86-091-VOL-2] p 102 N87-24486 End effector development study, volume 1
Dynamic analysis of the flexible boom in the N-ROSS	Space station electrical power distribution analysis using a load flow approach p 80 N87-26699	[FOK-TR-R-86-091-VOL-1] p 102 N87-25336
satellite [AD-A181488] p 72 N87-26966	a load flow approach p 80 N87-20099  PRC Kentron, Inc., Hampton, Va.	End effector development study. Volume 3:
Computer simulation of a rotational single-element	Effects of local vibrations on the dynamics of space	Appendices [FOK-TR-R-86-091-VOL-3] p 102 N87-25337
flexible spacecraft boom [AD-A181798] p 103 N87-26968	truss structures [AIAA PAPER 87-0941] p 17 A87-33739	The INMARSAT solar array: The first Advanced Rigid
Nevada Univ., Las Vegas.	Interdisciplinary analysis procedures in the modeling and	Array (ARA) to fly p 82 N87-28975 The Fokker Strongback solar array p 82 N87-28979
Robust nonlinear attitude control of flexible spacecraft p 60 A87-48273	control of large space-based structures p 22 A87-42678	Royal Netherlands Aircraft Factories Fokker,
New Mexico Univ., Albuquerque.	Princeton Univ., N. J.	Schiphol-Oost.  Acoustic effects on the dynamic of lightweight
An analysis of bipropellant neutralization for spacecraft	Groundbased studies of spacecraft glow and erosion	structures p 28 N87-20372
Northrop Services, Inc., Houston, Tex.	caused by impact of oxygen and nitrogen beams p 109 N87-26200	EURECA application of the Retractable Advanced Rigid Array (RARA) solar array p 82 N87-28973
Results on reuse of reclaimed shower water	Purdue Univ., West Lafayette, Ind.	Array (RARA) solar array p 82 N87-289/3
[SAE PAPER 860983] p 50 A87-38762	The effect of circumferential aerodynamic detuning on	S
0	coupled bending-torsion unstalled supersonic flutter [ASME PAPER 86-GT-100] p 166 A87-25396	
•	Preliminary performance characterizations of an	Science and Engineering Associates, Inc., Englewood, Colo.
Oak Ridge National Lab., Tenn.	engineering model multipropellant resistojet for space station application	Contamination assessment for OSSA space station IOC
The Oak Ridge National Laboratory's Robotics and Intelligent Systems Program	[AIAA PAPER 87-2120] p 93 A87-50197	payloads [NASA-CR-4091] p 53 N87-26086
[DE87-004627] p 101 N87-20774	Use of lightweight composites for GAS payload	[NASA-CR-4091] p 53 N87-26086 Science Applications International Corp., Schaumberg,
Application of a traction-drive 7-degrees-of-freedom telerobot to space manipulation	structures p 25 N87-20307	III.
[DE87-004616] p 101 N87-22231	n	Satellite servicing mission preliminary cost estimation model
Traction-drive telerobot for space manipulation	R	[NASA-CR-171978] p 136 N87-20335
[DE87-005326] p 102 N87-22233 Telerobotic technology for nuclear and space	RCA Aerospace and Defense, East Windsor, N.J.	Science Research Council, Chilton (England).  Report of the atmosphere panel p 161 N87-20633
applications	Development of a standard connector for orbital	Report of the atmosphere panel p 161 N87-20633 Search for Extraterrestrial Intelligence Inst., Los Altos,
[NASA-CR-180923] p 102 N87-22242 Application of advanced flywheel technology for energy	replacement units for serviceable spacecraft p 40 N87-29864	Calif.
storage on space station	RCA Astro-Electronics Div., Princeton, N. J.	Space Station gas-grain simulation facility - Application to exobiology p 127 A87-53002
[DE87-007657] p 68 N87-24028 Remote handling facility and equipment used for space	Design of an advanced two-phase capillary cold plate	Selenia S.p.A., Rome (Italy).
truss assembly		Data management system architecture options for space
[DE87-009121] p 103 N87-27408	[SAE PAPER 861829] p 41 A87-32663	
	RCA Communications Systems Div., Camden, N. J. Multiple Access Ku-band communications subsystem for	stations [SES/DNP/TR/002/85] p 115 N87-28585
Application of advanced flywheel technology for energy storage on space station p 74 N87-29933	RCA Communications Systems DIv., Camden, N. J.  Multiple Access Ku-band communications subsystem for the Space Station p 84 A87-31462	stations [SES/DNP/TR/002/85] p 115 N87-28585 Rendezvous and docking (RVD) long range RF sensor
storage on space station p 74 N87-29933  OAO Corp., Greenbelt, Md.	RCA Communications Systems Div., Camden, N. J. Multiple Access Ku-band communications subsystem for the Space Station p 84 A87-31462 Rice Univ., Houston, Tex.	stations [SES/DNP/TR/002/85] p 115 N87-28585
storage on space station p 74 N87-29933  OAO Corp., Greenbelt, Md.  Design of an advanced two-phase capillary cold plate [SAE PAPER 861829] p 41 A87-32663	RCA Communications Systems Div., Camden, N. J.  Multiple Access Ku-band communications subsystem for the Space Station p 84 A87-31462  Rice Univ., Houston, Tex.  Optimal trajectories for aeroassisted, coplanar orbital transfer p 54 A87-31681	stations [SES/DNP/TR/002/85] p 115 N87-28585 Rendezvous and docking (RVD) long range RF sensor definition study, executive summary [SES/ENG/ES-519/86] p 138 N87-28588 Sener S.A., Madrid (Spain).
storage on space station p 74 N87-29933  OAO Corp., Greenbelt, Md.  Design of an advanced two-phase capillary cold plate [SAE PAPER 861829] p 41 A87-32663  Office of Technology Assessment, Washington, D.C.	RCA Communications Systems DIv., Camden, N. J.  Multiple Access Ku-band communications subsystem for the Space Station p. 84 A87-31462  Rice Univ., Houston, Tex.  Optimal trajectories for aeroassisted, coplanar orbital transfer p. 54 A87-31681  Rochester Univ., N. Y.	stations [SES/DNP/TR/002/85] p 115 N87-28585 Rendezvous and docking (RVD) long range RF sensor definition study, executive summary [SES/ENG/ES-519/86] p 138 N87-28588 Sener S.A., Madrid (Spain). Service Manipulator Arm (SMA) for a Robotic Servicing Experiment (ROSE)
storage on space station p 74 N87-29933  OAO Corp., Greenbelt, Md.  Design of an advanced two-phase capillary cold plate [SAE PAPER 861829] p 41 A87-32663	RCA Communications Systems Div., Camden, N. J.  Multiple Access Ku-band communications subsystem for the Space Station p 84 A87-31462  Rice Univ., Houston, Tex.  Optimal trajectories for aeroassisted, coplanar orbital transfer p 54 A87-31681	stations [SES/DNP/TR/002/85] p 115 N87-28585 Rendezvous and docking (RVD) long range RF sensor definition study, executive summary [SES/ENG/ES-519/86] p 138 N87-28588 Sener S.A., Madrid (Spain). Service Manipulator Arm (SMA) for a Robotic Servicing

Severn Communications Corp., Severna Park, Md.	T	V
Radiation shielding requirements on long-duration space missions	•	
[AD-A177512] p 140 N87-21991	Technische Hochschule, Darmstadt (West Germany).  Active vibration damping of flexible structures using the	Vanderbilt Univ., Nashville, Tenn.
Shock and Vibration Information Center (Defense), Washington, D. C.	traveling wave approach p 71 N87-25360	The role of electronic mechanisms in surface erosion and glow phenomena p 137 N87-26181
The Shock and Vibration Bulletin, Part 1: Welcome	Technische Hogeschool, Delft (Netherlands).	The production of low-energy neutral oxygen beams by
invited Papers, Shipboard Shock, Blast and Ground Shock.	Status of series-resonant power conversion with high	grazing-incidence neutralization p 131 N87-26191
Shock Testing and Analysis [AD-A175224] p.29 N87-20574	internal frequencies. Support in definition of space station power interface	Vigyan Research Associates, Inc., Hampton, Va. Effects of varying environmental parameters on trace
Smithsonian Astrophysical Observatory, Cambridge,	[ESA-CR(P)-2319] p 79 N87-24533	contaminant concentrations in the NASA Space Station
Mass.	Maximum likelihood parameter identification of flexible	Reference Configuration
Investigation of plasma contactors for use with orbiting wires	spacecraft	[SAE PAPER 860916] p 47 A87-38708 Supercritical water oxidation - Concept analysis for
[NASA-CR-180922] p 129 N87-22509	[ETN-87-90235] p 38 N87-27705	evolutionary Space Station application
Analytical investigation of the dynamics of tethered	Technische Univ., Berlin (West Germany).	[SAE PAPER 860993] p. 51 A87-38770
constellations in Earth orbit, phase 2	Preliminary analysis of a prototype space solar power system	A simulation model for the analysis of Space Station gas-phase trace contaminants p 52 A87-53979
[NASA-CR-179149] p 130 N87-26083 Investigation of plasma contactors for use with orbiting	[ILR-MITT-168] p 79 N87-24532	Virginia Polytechnic Inst. and State Univ. Blackshurg
wires	Technische Univ., Munich (West Germany).	Simultaneous structure/control optimization of large
[NASA-CR-181422] p 131 N87-29591	Micrometeorite exposure of solar arrays	flexible spacecraft
Societe Europeenne de Propulsion, Vernon (France). SPOT/MEGS design and flight results obtained	p 82 N87-28982	[AIAA PAPER 87-0823] p 14 A87-33610 Spillover stabilization and decentralized modal control
p 103 N87-29009	Technology, Inc., Houston, Tex. Space Station Food System	of large space structures
Experiences of CNES and SEP on space mechanisms	[SAE PAPER 860930] p 48 A87-38720	[AIAA PAPER 87-0903] p 17 A87-33712
rotating at low speed p 104 N87-29868	Telespazio, S.p.A., Rome (Italy).	A comparison of active vibration control techniques -
Societe Nationale Industrielle Aerospatiale, Cannes (France).	Thermal-electrical dynamical simulation of spacecraft	Output feedback vs optimal control [AIAA PAPER 87-0904] p 56 A87-33713
Dynamic modeling and optimal control design for large	solar array p 83 N87-29004	Accuracy of derivatives of control performance using a
flexible space structures p 26 N87-20358	Tennessee Univ. Space Inst., Tullahoma.  A general method for dynamic analysis of structures	reduced structural model
Dynamic analysis of direct television satellite TV-SAT/TDF.1 p.86 N87-20360	overview p 31 N87-22707	[AIAA PAPER 87-0905] p 57 A87-33714
SPOT solar array in-orbit deployment results	Texas A&M Univ., College Station.	An approach to structure/control simultaneous optimization for large flexible spacecraft
evaluation p 83 N87-28986	Determination of the cross-sectional temperature	p 22 A87-46793
Aerospatiale solar arrays, in orbit performance	distribution and boiling limitation of a heat pipe	An analytical and experimental investigation of output
p 159 N87-28988 Computer simulation of deployment	p 40 A87-32175 Dynamic response of a viscoelastic Timoshenko beam	feedback vs. linear quadratic regulator
n 10 N87-29002	[AIAA PAPER 87-0890] p 16 A87-33708	[AIAA PAPER 87-2390] p 61 A87-50474
Southern California Inst. of Architecture, Santa	Robust eigensystem assignment for flexible structures	Equations of motion for maneuvering flexible spacecraft p 63 A87-52965
Monica.  Space station group activities habitability module study	[AIAA PAPER 87-2252] p 23 A87-50416	Modeling and control of flexible structures
[NASA-CH-4010] 0 165 N87-21585	A quasi-analytical method for non-iterative computation of nonlinear controls p 66 N87-22731	p 28 N87-20564
Space Telescope Science Inst., Baitimore, Md.	of nonlinear controls p 66 N87-22731  Electrochemical processing of solid waste	Maneuvering and vibration control of flexible
A crisis in the NASA space and earth sciences programme	[NASA-CR-181128] p 137 N87-25443	spacecraft p 67 N87-22734 Some problems in the control of large space
p 112 A87-37968 Spar Aerospace Ltd., Ste-Anne-de-Bellevue (Quebec).	Active vibration control in microgravity environment	Some problems in the control of large space structures
Optimization of aerospace structures subjected to	p 72 N87-26700	[AD-A179989] p 70 N87-25350
random vibration and fatigue constraints	Regenerative fuel cells for space applications p 84 N87-29938	An investigation of methodology for the control and
p 29 N87-20599 Spar Aerospace Ltd., Weston (Ontario).	Texas Univ., Austin.	failure identification of flexible structures
Modal testing of the Olympus development model	Lanczos modes for reduced-order control of flexible	p 38 N87-26921 The effect of nonlinearities on flexible structures
stowed solar array p 27 N87-20366	structures p 33 N87-22739	[AD-A181735] p 38 N87-27259
Spectrolab, Inc., Sylmar, Calif.  Design study of large area 8 cm x 8 cm wrapthrough	The undersea habitat as a space station analog: Evaluation of research and training potential	Aromatic polyester polysiloxane block copolymers:
cells for space station p 80 N87-26424	[NASA-CR-180342] p 53 N87-27405	Multiphase transparent damping materials
Sperry Space Systems, Durham, N.C.	Tokyo Univ. (Japan).	Modeling and computational algorithms for parameter
Common drive unit p 104 N87-29869 SRI International Corp., Menio Park, Calif.	Simultaneous structure/control optimization of large flexible spacecraft	estimation and optimal control of aeroelastic systems and
Spacecraft dielectric material properties and spacecraft	[AIAA PAPER 87-0823] p 14 A87-33610	large flexible structures
charging p 105 A87-33100	Toronto Univ. (Ontario).	[AD-A183302] p 11 N87-29893 Virginia Univ., Charlottesville.
Stanford Univ., Calif.	Arc propagation, emission and damage on spacecraft	Theory and application of linear servo dampers for large
A crisis in the NASA space and earth sciences programme p 112 A87-37968	dielectrics p 143 N87-26952	scale space structures p 72 N87-26970
State Univ. of New York, Buffalo.	Toshiba Corp., Kanagawa (Japan).  The design and development of a two-dimensional	Digital control system for space structure dampers
Vibration suppression using a constrained rate-feedback Threshold control strategy	adaptive truss structure p 40 N87-29860	[NASA-CR-181253] p 72 N87-27704
[AIAA PAPER 87-0741] p 6 A87-33665	TRW Space Technology Labs., Redondo Beach, Calif.	14/
Sterling Software, Palo Alto, Calif.	Spacecraft environment interaction investigation [AD-A179183] p.140 N87-23678	W
Synergetic plane-change capability of a conceptual	Application of physical parameter identification to	Washington State Liniu Bullman
aeromaneuvering-orbital-transfer vehicle [AIAA PAPER 87-2565] p 92 A87-49615	finite-element models p 34 N87-24505	Washington State Univ., Pullman.  Aeroassisted orbital maneuvering using Lyapunov
Stevens Inst. of Tech., Hoboken, N.J.		optimal feedback control
Integration of communications and tracking data	U	[AIAA PAPER 87-2464] p 93 A87-50509
processing simulation for space station	•	Washington Univ., Seattle.
Sverdrup Technology, Inc., Middleburg Heights, Ohio.	Umpqua Research Co., Myrtle Creek, Ore.	Radiation heat transfer calculations for space structures
Microgravity fluid management requirements of	Pre- and post-treatment techniques for spacecraft water recovery	[AIAA PAPER 87-1522] p 44 A87-44830
advanced solar dynamic power systems	[SAE PAPER 860982] p 50 A87-38761	Washington Univ., St. Louis, Mo.
p 77 N87-21153 Sverdrup Technology, Inc., Cleveland, Ohio.	Air Evaporation closed cycle water recovery technology	Temperature fields due to jet induced mixing in a typical OTV tank
Composite space antenna structures - Properties and	- Advanced energy saving designs	[AIAA PAPER 87-2017] p 93 A87-52247
environmental effects p 20 A87-38610 Sydney Univ. (Australia).	[SAE PAPER 860987] p 51 A87-38766	Numerical modelling of cryogenic propellant behavior
Nonequilibrium radiation during re-entry at 10 km/s	United Technologies Corp., East Hartford, Conn. The human quest in space; Proceedings of the	in low-G p 95 N87-21148
[AIAA PAPER 87-1543] n 135 A87-43060	wenty-fourth Goddard Memorial Symposium, Greenbelt,	WEA, Cambridge, Mass. Wave-mode coordinates and scattering matrices for
Systems Engineering Labs., Inc., Greenbelt, Md.	MD, Mar. 20, 21, 1986 p.2 A87-53082	wave propagation
Modeling and control of flexible structures [AD-A177106] p 29 N87-21388	United Technologies Corp., Windsor Locks, Conn.	[AD-A176998] p 29 N87-21030
Spectral factorization and homogenization methods for	Regenerable non-venting thermal control subsystem for extravehicular activity	Comparison of wave-mode coordinate and pulse
modeling and control of flexible structures	[SAE PAPER 860947] p 42 A87-38734	summation methods
[AD-A179726] p 35 N87-24517 Systems Science and Software, La Jolla, Calif.	University Coil. of North Wales, Bangor.	Wave propagation in transversely isotropic continuum
Theory of plasma contactors for electrodynamic tethered	A microgravity isolation mount p 161 N87-29861	models of LSS (Large Space Structures)
satelite systems p 85 A87-41609	University of Southern California, Los Angeles.  Evaluation of on-line pulse control for vibration	[AD-A177271] p 30 N87-22256
Documentation for the SHADO particle wake routine	suppression in flexible spacecraft	Whitmore Enterprises, San Antonio, Tex.
[AD-A181531] p 131 N87-26967	[NASA-CR-180391] p 70 N87-24513	An improved waste collection system for space flight

p 70 N87-24513

Whitmore Enterprises, San Antonio, Tex.
An improved waste collection system for space flight
[SAE PAPER 861014] p 119 A87-38784

## Yale Univ., New Haven, Conn.



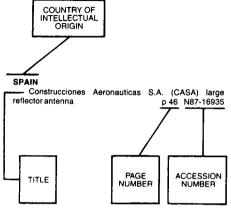
Yale Univ., New Haven, Conn.

Product energy distributions and energy partitioning in O atom reactions on surfaces p 108 N87-26180

York Univ., Toronto (Ontario).

Spacecraft charging in the auroral plasma: Progress toward understanding the physical effects involved p 142 N87-26949

#### Typical Foreign Technology Index Listing



Listings in this index are arranged alphabetically by country of intellectual origin. The title of the document is used to provide a brief description of the subject matter. The page number and the accession number are included in each entry to assist the user in locating the citation in the abstract section

#### AUSTRALIA

Adaptive tracking of dynamical model by uncertain nonlinearizable spacecraft

[AIAA PAPER 87-0940] p 57 A87-33738 Nonequilibrium radiation during re-entry at 10 km/s [AIAA PAPER 87-1543] p 135 A87-43060 A87-43060

#### В

#### RELGIUM

Solid Earth panel report

p 157 N87-20636

#### CANADA

Space structure vibration modes - How many exist? Which ones are important? p 11 A87-32120 The Canadian space program p 143 A87-32281 Transient dynamics of orbiting flexible members p 54 A87-32338 Effect of long-term exposure to LEO space environment on spacecraft materials p 106 A87-39426 Deployment dynamics of space structures p 58

A87-40074 The Canadian Robotic System for the Space Station [AIAA PAPER 87-1677] p 100 A87-41153 A formulation for studying dynamics of N connected p 21 A87-41574 flexible deployable members Evaluation of the infrared test method for the Olympus thermal balance tests A87-46682 Dynamics of gyroelastic spacecraft p 59 A87-47811 Global treatment of energy dissipation effects for multibody satellites p 62 A87-51610

Model reference adaptive control for large structural p 63 A87-52973 Modal testing of the Olympus development model stowed solar array N87-20366

Use of a video-photogrammetry system for the measurement of the dynamic response of the shuttle p 101 N87-20370 remote manipulator arm

Optimization of aerospace structures subjected to random vibration and fatigue constraints p 29 N87-20599

A formulation for studying steady state/transient dynamics of a large class of spacecraft and its p 35 N87-25357 Spacecraft charging in the auroral plasma: Progress toward understanding the physical effects involved

p 142 N87-26949 Arc propagation, emission and damage on spacecraft p 143 N87-26952

#### CHINA, PEOPLE'S REPUBLIC OF

Dynamics of a multibody system with relative translation on curved, flexible tracks p 58 A87-40867

#### FINLAND

Design of a beacon receiving system for the Olympus satellite p 86 A87-50157

#### FRANCE

ERATO orbital transfer vehicle with electronuclear power Study of the associated electronuclear generator

The Signe II gamma-ray burst experiment aboard the Prognoz 9 satellite p 150 A87-38443 Physiological requirements and pressure control of a spaceplane

[SAE PAPER 860965] n 150 A87-38747 PEEK (Polyether ether ketone) with 30 percent of carbon fibres for injection molding p 22 A87-44588

Ariane transfer vehicle (ATV) to supply Space Station p 152 A87-45257 [AIAA PAPER 87-1862]

Analysis and implementation of automation aspects in the Columbus and Hermes end to end systems [AIAA PAPER 87-2210] p 154 A87-48595

The astronaut and the robot - Short- and long-term cenarios for space technology p 101 A87-53991

Mechanical Qualification of Large Flexible Spacecraft scenarios for space technology Structures

[AD-A175529] p 26 N87-20355 Dynamic modeling and optimal control design for large flexible space structures N87-20358 p 26

Qualification of the faint object camera

p 127 N87-20359 Dynamic analysis of direct TV-SAT/TDF.1 television satellite p 86 N87-20360 Low frequency vibration testing on satellites

p 27 N87-20364 Proceedings of the European Symposium on Polar platform Opportunities Instrumentation Remote-Sensing (ESPOIR)

[ESA-SP-266] p 128 N87-20621

The Columbus program: An overview

p 156 N87-20623 Remote sensing applications: Commercial issues and opportunities for space station p 156 N87-20626 p 136 N87-20628 Servicing of the polar platform USA-Europe coordination and cooperation activities: Announcements of Opportunity p 170

Panel report on multidisciplinary instrumentation: New p 161 N87-20637 Panel report on new approaches to calibration and

validation p 157 N87-20638 Assessment of space station power system

p 79 N87-24530 [ATES-AN-86/466] Proceedings of the Second International Symposium on

Spacecraft Flight Dynamics [ESA-SP-255] p 171 N87-25354

Study of expert system applications to space projects p 115 N87-26057 [NE-51-867]

The Aerospace Environment at High Altitudes and its **Implications** for Spacecraft Charging Communications

[AGARD-CP-406] p 142 N87-26937 On the possibility of a several-kilovolt differential charge. in the day sector of a geosynchronous orbit

p 158 N87-26953

Study of data management system architecture options for space station

[MATRA-RF/176/0932-ISS-1] p 115 N87-28586 Proceedings of the Fifth European Symposium on Photovoltaic Generators in Space

[ESA-SP-267] p 81 N87-28959 The high performance solar array GSR3

p 81 N87-28972 MARECS and ECS anomalies: Attempt at insulation

defect production in Kapton p 82 N87-28980 SPOT solar array in-orbit deployment results evaluation p 83 N87-28986 Aerospatiale solar arrays, in orbit performance

p 159 N87-28988

Computer simulation of deployment

p 10 N87-29002 SPOT/MEGS design and flight results obtained

p 103 N87-29009 Experiences of CNES and SEP on snace mechanisms rotating at low speed p 104 N87-29868

## G

#### GERMANY.FEDERAL REPUBLIC OF

Highlights of the German Space Programme

p 143 A87-32282

Space launcher upper stages -Design for mission versatility and/or orbital operation p 132 A87-32474 Demands imposed on a surface tension propellant tank due to refuellability in the microgravity environment of outer

[DGLR PAPER 86-104] p 88 A87-36756 Intelligent flywheel energy storage units with additional functions for future space stations in near-earth orbits [DGLR PAPER 86-172] p 57 A87-36762

Flunking on Space Station cooperation? p 150 A87-37964 Status of the RITA - Experiment on EURECA

p 123 A87-38002 [AIAA PAPER 87-0988] Analysis of crew functions as an aid in Space Station interior layout

[SAE PAPER 860934] p 163 A87-38724 The capabilities of Eureca thermal control for future mission scenarios

[SAE PAPER 860936] A87-38725 System aspects of Columbus thermal control [SAE PAPER 860938] p 150 A87-38727

Columbus Life Support System and its technology development [SAE PAPER 860966] p 150 A87-38748

Life Support Subsystem concepts experiments of long duration for [SAE PAPER 860967] p 49 A87-38749

Europe prepares for manned orbited operations p 151 A87-39594 The industrial use of Spacelab p 168 A87-40286

The Space Station - Uses and users p 151 A87-40513

Thoughts on Europe's future in space

p 151 A87-41219 Carbon fibre slotted waveguide arrays p 85 A87-41302

The single-stage reusable ballistic launcher concept for economic cargo transportation p 135 A87-41573 Dynamic behavior of astronauts and satellites outside an orbiting space station under the influence of thrust

p 52 A87-41666 Status and tendencies for low to medium thrust

propulsion systems [IAF PAPER 86-162] p 90 A87-42680 Control of an autonomous spacecraft rendezvous and

docking maneuver by means of image processing [DGLR PAPER 86-122] n 101 A87-48156 The problem of radiation exposure in the Space

Station [DGLR PAPER 86-175] p 153 A87-48157 Scientific user requirements for microgravity research

(European aspects) [AIAA PAPER 87-2195] p 153 A87-48581

Automated software production [AIAA PAPER 87-2219] p 2 A87-48601

Evolution of data management systems from Spacelab		Automatic docking maneuver and attitude control s
to Columbus		ystem p /1 N67-25395  Data management system architecture options for space
[AIAA PAPER 87-2227] p 154 A87-48605	INDIA	stations
Radiation protection problems for the Space Station and	Stability of time varying linear systems	[SES/DNP/TR/002/85] p 115 N87-28585
approaches to their mitigation p 154 A87-49030		Rendezvous and docking (RVD) long range RF sensor
Life support subsystem concepts for botanical	A basis change strategy for the reduced gradient method and the optimum design of large structures	definition study, executive summary
experiments of long duration [MBB-UR-E-907-86-PUB] p 154 A87-49967	p 23 A87-48341	[SES/ENG/ES-519/86] p 138 N87-28588
An advanced wind scatterometer for the Columbus Polar	Dynamics of an actively controlled flexible Earth	Advanced Solar GaAs Array (ASGA) experiment on EURECA: Flight objectives and instrument configuration
Platform payload p 155 A87-53117	observation satellite p 71 N87-25356	p 83 N87-28985
'HEXE' - X-ray observatory in space	Design and fabrication of Stretched Rohini Satellite-1	Organic Rankine cycle power conversion systems for
p 155 A87-53558	solar array p 83 N87-29006	space applications p 159 N87-28989
The GDR and the Soviet space program - The optical	INTERNATIONAL ORGANIZATION	Thermal-electrical dynamical simulation of spacecraft
instrument sector of the GDR contributions p 155 A87-53559	Europe's future in space p 143 A87-32278	solar array p 83 N87-29004
Power plants in space p 155 A87-53560	Enhancement of solar absorptance degradation due to	
Recent developments and future trends in structural	contamination of solar radiator panels in geosynchronous	J
dynamic design verification and qualification of large	orbit - Correlation of flight data and laboratory	<u> </u>
flexible spacecraft p 156 N87-20357	measurements p 144 A87-32346	JAPAN
Dynamic qualification of spacecraft by means of modal	Space Station - Overview of the European concept of	International Symposium on Space Technology and
evnthesis p.26 N87-20363	Columbus programme status and content p 145 A87-32528	Science, 15th, Tokyo, Japan, May 19-23, 1986,
Modal-survey testing for system identification and	Eureca - A first step towards the Space Station	Proceedings. Volumes 1 & 2 p 166 A87-32276
dynamic qualification of spacecraft structures p 27 N87-20365	p 146 A87-32537	Japanese space program p 143 A87-32285
Spacecraft qualification using advanced vibration and	The European space programme p 150 A87-37962	Prediction of random vibrational responses of a large spacecraft in acoustic environment by BLPF method
modal testing techniques p 27 N87-20368	Modal-survey testing of the Olympus spacecraft	p 144 A87-32334
Multi-axis vibration tests on spacecraft using hydraulic	p 152 A87-42266	Structural design and component tests of large
exciters p 8 N87-20373	A model for the estimation of the operations and	geostationary satellite bus p 144 A87-32335
Furopean utilization aspects studies	utilisation costs of an international space station	Model study of simplex masts p 144 A87-32339
p 156 N87-20624	p 168 A87-42267	Design consideration of mechanical and deployment
Land panel report p 128 N87-20634	Materials for space applications p 106 A87-44741	properties of a coilable lattice mast p 12 A87-32340
Stress and deformation analysis of lightweight	ESA's future integrated space data system [AIAA PAPER 87-2190] p 153 A87-48578	Deployable surface truss concepts and two-dimensional
composite structures [MBB-UD-489/86] p 30 N87-22269	[AIAA PAPER 87-2190] p 153 A87-48578 ESA software engineering standards for future	adaptive structures p 144 A87-32341
	programmes	Development of graphite epoxy space structure p 105 A87-32342
Investigation for damping design and related nonlinear	AIAA PAPER 87-22071 p 154 A87-48592	Thermal verification method for large sized spacecraft
vibrations of spacecraft structures [EMSB-64/85] p 35 N87-24516	Comparison of different attitude control schemes for	p 144 A87-32368
Preliminary analysis of a prototype space solar power	large communications satellites	A thermally-pumped heat transport system
system	[AIAA PAPER 87-2391] p 61 A87-50475	p 40 A87-32369
[iLR-MITT-168] p 79 N87-24532	Microgravity experiments onboard Eureca p 155 A87-53554	Development of fluid loop system for spacecraft
Botanical payloads for platforms and space stations	From Eureca-A to Eureca-B p 155 A87-53916	p 144 A87-32370
[MBB-UR-E-921/86] p 158 N87-25340	The Columbus system baseline and interfaces	Laboratory simulation of plasma interaction with high voltage solar array p 145 A87-32388
Active vibration damping of flexible structures using the	p 156 A87-53923	voltage solar array p 145 A87-32388  Thermal deformation and electrical degradation of
traveling wave approach p 71 N87-25360	Cooperation between Europe and the United States in	antenna reflector with truss backstructure
Possibilities of the further development of Columbus to	space (The Fulbright 40th Anniversary Lecture)	p 12 A87-32405
an autonomous European space station [MRR-UR-E-922/86] p 158 N87-25418	p 170 A87-53924	Local control for large space structures
[mas on a real of	ITALY	p 54 A87-32440
Fiber composites in satellites [MBB-UD-492/86] p 107 N87-25430	On the dynamical stability of the space 'monorail' p 148 A87-34047	A consideration to vibration control for a large space
[MBB-UD-492/86] p 107 N8/-25430 The Radarsat Modular Opto-electronic Multispectral	Advances by the Soviet Union in space cooperation and	structures p 54 A87-32441
Scanner (R-MOMS): A potential candidate for the Polar	commercial marketing made 1986 a landmark year	Flexibility control of torsional vibrations of a large solar array p 12 A87-32442
Orbiting Platform (POP) also	p 149 A87-34595	Two-time-scale design of robust controllers for large
[MBB-UR-873/86] p 130 N87-25506	Tether system and controlled gravity	structure systems p 12 A87-32443
A study of fluid transfer management in space	[AAS PAPER 86-240] p 124 A87-38573	Vibration control for a linked system of flexible
[FTMS-RPT-006] p 97 N87-26058	Infrared test technique validation on the Olympus	structures p 55 A87-32444
Development of experimental/analytical concepts for	satellite [SAE PAPER 860939] p 150 A87-38728	Precise pointing control of flexible spacecraft
structural design verification	The Tethered Satellite System as a new remote sensing	p 55 A87-32446
[ESA-CR(P)-2340] p 36 N87-26075	platform p 124 A87-39183	A preliminary study on a linear inertial actuator for LSS control p 55 A87-32447
The evolution of a serviceable EURECA [MRR-IJR-E-923/86] p 121 N87-26841	Non-intrusive techniques for thermal measurements in	Control of flexible solar arrays with consideration of the
	microgravity fluid science experiments	actuator dynamics of the reaction wheel
Control engineering tasks in the framework of the	p 151 A87-39836	p 55 A87-32448
Columbus program {MBB-UR-E-912/86} p 158 N87-26842	Columbus pressurized modules p 153 A87-46945	Control of a flexible space manipulator
Preliminary study of a Biological and Biochemical	Evaluation of the built-in stresses and residual distortions	p 99 A87-32449
Analysis Facility (BBAF) for Columbus: Executive	on cured composites for space antenna reflectors applications p 22 A87-47327	Preliminary experimental study on the oxygen separating
summary	The hardware/software architecture of the Columbus	and concentrating system for CELSS p 46 A87-32455  Development of carbon dioxide removal system
[ESA-CR(P)-2338] p 158 N87-27698	pressurized module element	Experimental study of solid amines p 145 A87-32456
Study on investigation of the attitude control of large	[AIAA PAPER 87-2211] p 154 A87-48596	Gas and water recycling system for IOC vivarium
flexible spacecraft. Phase 1, volume 1: Technical report	The tethered satellite system for low density	experiments p 46 A87-32457
[ESA-CR(P)-2361-VOL-1] p 73 N87-27706	aerothermodynamics studies p 127 A87-52450	Water recycling system using thermopervaporation
Study on investigation of the attitude control of large	Effect of modal damping in modal synthesis of spacecraft structures p 26 N87-20362	method p 46 A87-32458
flexible spacecraft. Phase 2, volume 1: Executive	structures p 26 N87-20362 Active structural controllers emulating structural	Water recycling for Space Station p 46 A87-32459
summary [FSA-CR(P)-2361-VOL-1] p 73 N87-27707	elements by ICUs p 27 N87-20367	System and operation analyses of OTV Network - A
	Payload data management scheme planned for Earth	new space transportation concept p 145 A87-32475 Observation of precipitation from space by the weather
Study on the investigation of the attitude control of large flexible spacecraft. Phase 2, volume 2: Technical report	observation sensors to be flown on the polar platforms	radar p 145 A87-32507
[ESA-CR(P)-2361-VOL-2] p 73 N87-27708	in the framework of the space station/Columbus	Preliminary results of CHARGE-2 tethered payload
Study on investigation of the attitude control of large	program p 114 N87-20630	experiment p 121 A87-32521
flexible spacecraft, phase 3	Data management panel report p 114 N87-20639	Space Station program in a long-range space
[ESA-CR(P)-2361-VOL-4] p 73 N87-27709	Attitude and Orientation System (AOCS) tasks on	development scenario of Japan p 145 A87-32530
AMOC: An alternative module configuration for	Rendezvous and Docking (RVD) (docking-undocking phases). Architecture of the whole simulator, volume 2	Status of Japanese Experiment Module design
advanced solar arrays in low Earth orbits	[LP-RP-Al-204-VOL-2] p 68 N87-24490	p 145 A87-32531
p 159 N87-28968	Attitude and Orientation Control System (AOCS) tasks	Development of exposed deck of Japanese experiment p 145 A87-32532
Improved solar generator technology for the EURECA	on Rendezvous and Docking (RVD) (docking-undocking	module p 145 A87-32532 On the payload-tether technology providing the
low Earth orbit p 159 N87-28974	phases). Simulation set-up and results, volume 3	microgravity circumstances in the proximity of the Space
Micrometeorite impact on solar panels	[LP-RP-AI-204-VOL-3] p 69 N87-24491	Station p 122 A87-32533
p 82 N87-28981	Attitude and Orientation Control System (AOCS) tasks	An enclosed hangar concept for large spacecraft
Micrometeorite exposure of solar arrays p 82 N87-28982	on Rendezvous and Docking (RVD) (docking-undocking	servicing at Space Station p 146 A87-32534
·	phases). Docking-undocking phase analysis [LP-RP-AI-204-VOL-1] p 70 N87-24514	Solar concentrator system for experiments in the Space
The extendable and retractable mast as supporting tool for rigid solar arrays p 39 N87-29012	The Columbus program p 157 N87-25031	Station p 146 A87-32535
for rigid solar arrays p 39 N87-29012 Absolute indoor calibration of large area solar cells	Sampled nonlinear control for large angle maneuvers	Advanced technology experiment onboard space
p 159 N87-29015	of flexible spacecraft p 71 N87-25358	platform p 122 A87-32536

Concept design and cost estimation of a free-flying	Acoustic effects on the dynamic of lightweight	Shape control of the directional pattern in a
space platform p 146 A87-32539	structures p 28 N87-20372	microwave-beam power transmission channel
Payload boomerang technology for space experiments	The Earth observation activities of the European Space	p 148 A87-34345
at very low gravity level p 146 A87-32540	Agency and the use of the polar platform of the	The synthesis of the power transmission channel for a
Autonomous decentralized system concept for Space Station p 146 A87-39541	International Space Station p 128 N87-20622	satellite solar power station p 75 A87-35799
p 140 7101 0E041	Working group on Earth observation requirements for the Polar Orbiting Platform Elements of the International	Problems of mechanical system configuration control
Japanese experiment module data management and communication system p 147 A87-32542	Space Station (the POPE Working Group)	p 149 A87-35877
Concept study of regenerable carbon dioxide removal	p 128 N87-20625	Legal problems concerning manned space flight
and oxygen recovery system for the Space Station	ESA Columbus polar platform design concept	p 151 A87-40339 K.E. Tsiolkovskii and problems in the development of
p 46 A87-32544	p 156 N87-20627	science and technology p 151 A87-40342
Study of actuator for large space manipulator arm	Orbit configurations p 156 N87-20629	Expected size of a crater resulting from the impact of
p 12 A87-32545	Cooperation of the International Space Station partners	a micrometeorite p 119 A87-41870
A master-slave manipulator system for space use	in the preparation of the use of space station elements for Earth observation (platform and payload aspects)	Effect of crew motions on the spatial position of a
p 147 A87-32546	p 128 N87-20631	spacecraft p 152 A87-41954
Development of sensors for remote manipulator system	The orbit configuration panel report	The Gagarin scientific lectures in astronautics and aviation, 1985
of Japanese Experiment Module p 147 A87-32547	p 157 N87-20640	0-1-
Structure and function of Deployable Truss Beam	Panel report on the polar platform servicing approach	Determination of the natural frequencies of the
(DTB) p 12 A87-32548	and its implications p 136 N87-20641	longitudinal and torsional vibrations of truss structures with
Evaluation testing of a mechanical actuator component operating in a simulated space environment	End effector development study. Volume 2: Service End Effector subsystem specification (SEESSPEC)	attached rigid bodies p 152 A87-46121
p 160 A87-32549	[FOK-TR-R-86-091-VOL-2] p 102 N87-24486	The Gagarin Scientific Lectures on Astronautics and
Simultaneous structure/control optimization of large	Status of series-resonant power conversion with high	Aviation, 1986 p 169 A87-51869
flexible spacecraft	internal frequencies. Support in definition of space station	Structure and design of spacecraft
[AIAA PAPER 87-0823] p 14 A87-33610	power interface	p 155 A87-51870
New concepts of deployable truss units for large space	[ESA-CR(P)-2319] p 79 N87-24533	Space biology and medicine on the twenty-fifth anniversary of the first spaceflight of Yuriy Alekseyevich
structures	End effector development study, volume 1	Gagarin p 157 N87-20732
[AIAA PAPER 87-0868] p 14 A87-33632	[FOK-TR-R-86-091-VOL-1] p 102 N87-25336	Evaluation of physical work capacity of cosmonauts
Adaptive planar truss structures and their vibration	End effector development study. Volume 3: Appendices	aboard Salyut-6 station p 157 N87-20735
characteristics		Status of orbital astronomy projects
[AIAA PAPER 87-0743] p 148 A87-33667	[FOK-TR-R-86-091-VOL-3] p 102 N87-25337 Electrostatic immunity of geostationary satellites	p 128 N87-21973
Alternative methods to fold/deploy tetrahedral or pentahedral truss platforms p 19 A87-34467	p 143 N87-26957	Plans for industrialization of space discussed
Communication missions for geostationary platforms	Maximum likelihood parameter identification of flexible	p 157 N87-21979
p 84 A87-34797	spacecraft	USSR Report: Space [JPRS-USP-86-004] p 158 N87-27687
Development of harmonic drive actuator for space	[ETN-87-90235] p 38 N87-27705	Pravda commentary, photos of Mir orbital station
manipulator p 149 A87-35076	Summary of recent SAR instrument studies	p 158 N87-27688
A study on singularity of single gimbal CMG systems	p 159 N87-27865	IKI department head on orbital power plants
p 149 A87-35077	EURECA application of the Retractable Advanced Rigid	p 158 N87-27693
Automatic generation of stochastically dominant failure	Array (RARA) solar array p 82 N87-28973	Progress in theory, technology of space materials
modes for large-scale structures p 149 A87-37853 Development of the electrical power subsystem for the	The INMARSAT solar array. The first Advanced Rigid Array (ARA) to fly p 82 N87-28975	science p 158 N87-27695
electric propulsion experiment onboard the Space Flyer	High power solar array technologies	Optimizing experimental programs in operational
Unit (SFU)	p 82 N87-28976	planning of research carried out from spacecraft
[AIAA PAPER 87-1040] p 76 A87-39628	The Fokker Strongback solar array p 82 N87-28979	p 160 N87-29553 UNITED KINGDOM
Development of control and monitor subsystem for	Stopping differential charging of solar arrays	British activities in space p 143 A87-32280
electric propulsion experiment onboard Space Flyer Unit	p 83 N87-28984	Design of a polar platform with an earth observation
(SFU)	Space 2000 in Europe p 159 N87-29024	payload p 122 A87-32538
[AIAA PAPER 87-1041] p 76 A87-39629	_	Space Station - Opportunities for the life sciences
Japanese Experiment Module (JEM) preliminary design status	R	p 122 A87-34871
long-to annual desired	•	Mechanical design of the Eurostar platform
communications - An overview p 152 A87-43156	ROMANIA (RUMANIA)	p 149 A87-34874
On-board K- and S-band multi-beam antennas	Permanent-magnet linear alternators. I - Fundamental	The SERVICE concept p 134 A87-36362
p 86 A87-46281	equations. II - Design guidelines p 76 A87-39735	Coded mask telescopes for X-ray astronomy
Japanese space information system overview	_	p 123 A87-37785 Mir in action p 150 A87-37971
[AIAA PAPER 87-2191] p 153 A87-48579	S	The use of electric propulsion on low earth orbit
Japanese customer needs for Space Station		spacecraft
[AIAA PAPER 87-2193] p 153 A87-48580	SPAIN	[AIAA PAPER 87-0989] p 88 A87-38003
Japanese data relay satellite system [AIAA PAPER 87-2199] p 154 A87-48585	Service Manipulator Arm (SMA) for a Robotic Servicing	A UK large diameter ion thruster for primary
Mission scheduling expert system and its space station	Experiment (ROSE)	propulsion
applications	[ESA-CR(P)-2347] p 103 N87-28260	[AIAA PAPER 87-1031] p 89 A87-38015
[AIAA PAPER 87-2221] p 7 A87-48602	<b>-</b>	An evolutionary approach to the development of a CELSS based air revitalization system
Modeling and control of torsional vibrations in a flexible	i	[SAE PAPER 860968] p 49 A87-38750
structure p 60 A87-50033		Columbus/Space Station United Kingdom Utilisation
Low-authority control of large space structures by using tendon control system	TAIWAN	Study 1985/6 Report - Executive Summary
[AIAA PAPER 87-2249] p 60 A87-50413	New time-domain identification technique p 58 A87-40869	p 151 A87-41429
The mission function control for deployment and retrieval	Orbital debris environment resulting from future activities	A polar platform for the remote sensing needs of ecology
of subsatellite	in space p 139 A87-44392	and agriculture - A view from the U.K.
[AIAA PAPER 87-2326] p 126 A87-50447	p 100 7(01-17002	p 125 A87-41430
Development of metal matrix composites in R & D	U	Space: New opportunities for all people; Selected Proceedings of the Thirty-seventh International
Institute of Metals & Composites for Future Industries	Ų	Astronautical Congress, Innsbruck, Austria, Oct. 4-11,
p 107 A87-51772	U.S.S.A.	1986 p 168 A87-41568
Development of full scale deployable CFRP truss for	Gravity-gradient stabilization of the Salyut 6-Soyuz	Attitude control of a spacecraft using an extended
space structure p 25 A87-51793 Taylored laminates with null or arbitrary coefficient of	orbital complex p 147 A87-32801	self-organizing fuzzy logic controller p 59 A87-41617
thermal expansion p 107 A87-51794	Stability in the relative equilibrium positions of space	Space Station opportunity for UK in earth sensing
Development of a small-sized space manipulator	stations at triangular libration points in the	p 152 A87-41678
p 101 A87-51979	photogravitational three-body problem p 1 A87-32802	The Soviet space shuttle programme
The design and development of a two-dimensional	Contribution of the German Democratic Republic (East	p 153 A87-47302 Identification of large space structures - A factorization
adaptive truss structure p 40 N87-29860	Germany) to the 'Intercosmos' program of study of	approach p 25 A87-52966
	materials in space aboard the orbiting station Salyut 6	lon thrusters advance p 93 A87-54196
N	p 147 A87-32814 Instability of an elastic filament in orbit around a	Infra-red astronomy after IRAS p 127 A87-54197
• •	gravitating center p 148 A87-32815	Developing Space Station, II - Power, rendezvous
IETHERLANDS	Critical length for stable elongated orbiting structures	docking and remote sensing are important elements of
Living in space: A handbook for space travellers	p 148 A87-32819	the Space Station p 127 A87-54198
p 162 A87-33475	Choice of the optimal angular position of a spacecraft	Influence co-efficient testing as a substitute for modal
Quality monitoring in two-phase heat transport systems	in the constant-solar-orientation flight segment	survey testing of large space structures
for large spacecraft	p 148 A87-34207	p 27 N87-20369 Report of the atmosphere panel p 161 N87-20633
[SAE PAPER 860959] p 42 A87-38743	Optimization of a program of experiments in connection	Ocean-ice panel report p 161 N87-20633
Survey of solar-dynamic space power - The Stirling option p 77 A87-42265	with the operational planning of studies carried out with	Ideas for educational physics experiments in space
		F7 on politica in apace
р 77 А87-42265	a spacecraft p 148 A87-34208	p 130 N87-25033

FOREIGN TECHNOLOGY INDEX

## UNITED KINGDOM

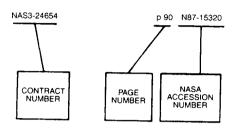
The use of Pi2 pulsations as indicators of substorm effects at geostationary orbit p 142 N87-26942 Radiation charging and breakdown of insulators p 143 N87-26954 Surface modification to minimise the electrostatic charging of Kapton in the space environment p 87 N87-26959

p 87 N87-26959 p 82 N87-28977

GaAs concentrator solar arrays

# COZFRACE

## Typical Contract Number Index Listing



Listings in this index are arranged alpha-numerically by contract number. Under each contract number, the accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order with the AIAA accession numbers appearing first. The accession number denotes the number by which the citation is identified in the abstract section. Preceding the accession number is the page number on which the citation may be found.

AF-AFOSR-0017-83	. р70	N87-25350
AF-AFOSR-0090-86		N87-27259
AF-AFOSR-0198-81		N87-30107
AF-AFOSR-0201-83		
AF-AFOSR-0287-85		N87-29893
AF-AFOSR-0352-85		N87-22252
AF-AFOSR-0361-83	•	N87-23683
AF-AFOSR-82-0242		A87-42505
AF-AFOSR-83-0017		A87-33710
AF-AFOSR-83-0318	•	A87-46301
AF-AFOSR-84-0309		A87-50504
AF-AFOSR-85-0220		A87-33665
	p 59	A87-42505
AF-AFOSR-85-0253		A87-41052
CDC-24ST-36001-3-1898		A87-41052
CNR-PSN-84-048	p 127	A87-52450
CNR-PSN-85-082		A87-52450
DAAG29-78-C-0020	p 59	A87-46301
DAAG29-82-K-0094		A87-50503
DE-AC02-76CH-00016	p 99	N87-28405
DE-AC05-84OR-21400	p 101	N87-20774
	p 101	N87-22231
	p 102	N87-22233
	p 102	N87-22242
	p 68	N87-24028
	p 103	N87-27408
	p 74	N87-29933
DE-Al03-86SF-16013	p 79	N87-25838
ESA-1682/84-NL-AN	p 102	N87-24486
	p 102	N87-25336
	p 102	N87-25337
ESA-4750/81-NL-AK(SC)	p 68	N87-24490
, ,	p 69	N87-24491
	p 70	N87-24514
ESA-5170/85-NL-AN(SC)	p 79	N87-24530
, , ,	p 79	N87-24533
ESA-6093/84-NL-GM(SC)	p 138	N87-28588
ESA-6238/85-NL-AN	p 82	N87-28982
ESA-6607/85-F-HEW	p 158	N87-27698
ESTEC-5166/82-NL-PB(SC)	p 36	N87-26075
ESTEC-5310/82-NL-BI	p 73	N87-27706
	p 73	N87-27707
	p 73	N87-27708
	p 73	N87-27709
ESTEC-5326/83-NL-PB(SC)	p 35	N87-24516
ESTEC-5996/84-NL-PP(SC)	p 115	N87-28586
ESTEC-5997/84-NL-PP(SC)	p 115	N87-28585
	p 97	N87-26058
ESTEC-6028/84-NL-JS	p 115	N87-26057
ESTEC-6174/85-NL-AN(SC)	p 103	N87-28260
F04701-82-C-83	p 87	N87-26961

F04701-8	5-C-0086	D00016		_	00	407 450	~~
	5-C-0086			•	92	A87-453	
104701-0	JJ-C-0000	•••••	••••••		138		
				•			
E10000 0	3-K-0028				110		
					142		
	4-C-0038				140		
	6-C-0056				131	N87-269	
F29601-8			••••••		31	N87-227	
F33615-8			•		55	A87-3273	
F33615-8			•••••		58	A87-3964	
F33615-8 F33615-8						A87-335	
F33615-8		***************************************			110	N87-2858	
F33615-8		***************************************	•••••		21 60	A87-4086 A87-5041	
F49620-8		***************************************	······		61	A87-5047	
F49620-8					25	A87-5050	
					29	N87-2138	
					35	N87-2451	
F49620-8	4-K-0010				72	N87-2580	
F49620-8					18	A87-3374	1
F49620-8	5-C-0148		• • • • • • • • • • • • • • • • • • • •	. р	29	N87-2103	30
					30	N87-2199	2
	<b></b>			р		N87-2225	6
F49620-8			••••••	. p		N87-2102	
F49620-8		***************************************		•		A87-3359	
F499620-			••••••	•	108	N87-2618	
JPL-9564		•••••	••••••			A87-3168	-
JPL-95711 NAGW-21	14			. р		A87-3265	
NAGW-45	s	••••••	••••••		106	A87-4979	
NAGW-65					115	N87-2481	
NAGW-72					157 135	N87-2199 A87-4306	
NAGW-81					108	N87-2617	
NAGW-82			••••••		108	N87-2617	
NAG1-126		*****************				N87-2636	
NAG1-138				p.		N87-2741	_
NAG1-215				p:		N87-2637	
NAG1-224				p.		A87-3361	
				p t	56	A87-3371	3
				p 2	22	A87-4679	3
				pθ	31	A87-5047	4
NAG1-225				рe	33	A87-5296	5
				рe		N87-2273	
NAG1-258		•••••	••••••	Р 1		N87-3010	
NAG1-349 NAG1-41	***************************************	••••••	•••••	p 7		N87-2770	
NAG1-41 NAG1-436	***************************************			p 4		A87-44830	
11/10/1-400	***************************************			р 5 р 6		A87-39958	
NAG1-438				р3		A87-5056* N87-27266	
NAG1-541		·····	**************	р3		N87-2959	
NAG1-551				p 4		N87-2607	
				p 4		N87-26936	
				p 4	5	N87-27702	
NAG1-603				p 1	7	A87-33712	
				р 5		A87-33714	ļ
NAG1-612			••••••	р3		N87-26071	
NAG1-613				р3		N87-26397	
NAG1-636	***************************************	•••••••	•	p 6		A87-50561	
NAG1-655		•••••••	•••••	p 7		N87-24513	
17101 000				p 2		A87-50471 N87-26583	
NAG1-660				p 1		A87-49618	
				p 1		N87-26927	
NAG1-728	***************************************			p 4		N87-29899	
NAG2-348						A87-35222	
NAG3-578						A87-52247	
VAG3-580	***************************************					A87-35718	
NAG3-620		•••••		p 1:	29	N87-22508	i
JACO 20-				p 1		N87-26946	
NAG3-637						A87-52252	
NAG3-695 NAG3-696	•••••					A87-42585	
NAG5-520	•••••					N87-29633	
**************		••••••				N87-23980	
				p 36		N87-25605	
				р 74 р 40		N87-29713 N87-29898	
AG5-749				р 40 р 34		N87-29898 N87-23980	
		••••••		D 36		N87-23980 N87-25605	
				p 74		N87-29713	
				p 40		N87-29898	
IAG5-780				p 10		A87-45797	
IAG5-874						N87-23066	
						N87-26200	

NAG8-532		. p6	A87-33561
NAG8-592	,	р 28 . р 14	N87-20569
NAG9-126		p 53	N87-26086
	***************************************	p 13	N87-29591
NAG9-140 NAG9-192		. р 16 . р 137	A87-33708 7 N87-25443
NASA ORD	ER L-76724-B	. p 120	
NAS1-1581 NAS1-1639			N87-30107
NAS1-1661			N87-30107 N87-21020
NAS1-1721	0	p 10	N87-24709
NAS1-1736 NAS1-1753		р 60 р 65	A87-48273 N87-21994
NAS1-1766	0	. р7	A87-33728
NAS1-1791	9	p 47 p 51	A87-38708 A87-38770
		p 52	A87-53979
NAS1-1801: NAS1-1801:		p 35 p 30	N87-25349
NAS1-1803		p 9	N87-21987 N87-21995
NAS1-18229		p 36	N87-25606
NAS1-18267 NAS1-550		p 120 p 47	N87-20340 A87-38708
	***************************************	p 52	A87-53979
NAS2-11530 NAS2-11687		p 112	
NAS2-11007		p 50 p 118	A87-38764 A87-33003
		p 163	A87-38724
NAS3-23353 NAS3-23773		p 54 p 135	N87-29594 A87-41161
		p 136	A87-46000
NAS3-23869	•	p 137	N87-26097
NAS3-23881		р7 р85	A87-41611 A87-41609
NAS3-23893	,	p 140	A87-51713
NAS3-23693		р 98 р 97	N87-26129 N87-24641
NAS3-24662		p 81	N87-28825
NAS3-24666		p 78 p 79	N87-23695 N87-23696
NAS5-2750		p 119	A87-48597
NAS5-29124 NAS5-29248		p 113	A87-45485
NAS5-29300		p 41 p 119	A87-32663 A87-38742
NAS7-918		p 11	A87-32336
		p 15 p 15	A87-33634 A87-33658
		p 18	A87-33752
		p 22 p 79	A87-47812 N87-25838
		p 141	N87-26173
NAS7-936		p 139 p 108	A87-38623 N87-26189
NAS8-31778		p 97	N87-26081
NAS8-33982 NAS8-35096		p 138	A87-34460
147.00-03030	***************************************	р 97 р 3	N87-26062 N87-26063
		p 3	N87-26064
		р3 р4	N87-26065 N87-26066
11400 05 171		p 4	N87-26067
NAS8-35471 NAS8-35971		p 124 p 98	A87-38757 N87-26116
NAS8-36102		p 53	N87-26086
NAS8-36105 NAS8-36107		p 126	A87-44533
NAS8-36400		р 91 р 64	A87-45191 N87-20665
NAS8-36418		p 91	A87-45255
NAS8-36420 NAS8-36426		р 17 р 39	A87-33709 N87-28581
		p 39	N87-28582
NAS8-36427		p 4 p 134	N87-28583 A87-38769
NAS8-36488		p 62	A87-50558
NAS8-36526		p 67	N87-22758
NAS8-36570	· · · · · · · · · · · · · · · · · · ·	p 91 p 71	A87-45259 N87-25801
NAS8-36606		125	A87-40859
NAS8-36617		130	N87-26083
	J	131	N87-29585

NAS8-4496 ......

A87-32175

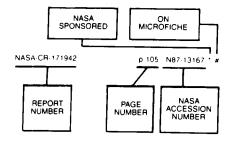
NAS9-15800	p 165	N87-22744
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	p 137	N87-25339
NAS9-16895	р 53 р 136	N87-29117 N87-20335
NAS9-17207 NAS9-17299	p 120	N87-20351
NAS9-17332	p 85	A87-45483
NAS9-17471	р 84 р 85	A87-31462 A87-45519
NAS9-17472 NAS9-17560	p 58	A87-37295
	p 62	A87-50531
NAS9-17613 NAS9-17900	р 81 р 137	N87-28188 N87-25339
NCA2-191	p 93	A87-50509
NCC2-210	р 130 р 53	N87-25767 N87-27405
NCC2-286 NCC2-356	p 165	N87-21585
NERC-P60/G6/16	p 125	A87-41430
NGT-01-008-021 NGT-33-183-801	р 67 р 6	N87-22752 A87-33665
NSERC-A-4183	p 11	A87-32120
NSERC-A-8730	p 59 p 21	A87-47811 A87-41052
NSERC-G-1547	p 21	A87-41574
	p 35	N87-25357 A87-32338
NSERC-67-1547	р 54 р 58	A87-32336 A87-40074
NSF CPE-81-14348	p 108	N87-26180
NSF DMS-84-01297	p 21	A87-41052 A87-39735
NSF ECS-83-14238	р 76 р 58	A87-39958
	p 62	A87-50561
NSF INT-84-08315	р 76 р 11	A87-39735 N87-30107
NSF MCS-82-00883	p 11	N87-30107
NSF MEA-83-51807	p 6	A87-33665
NSG-1414	p 59 p 12	A87-42505 A87-32337
1430-1414	p 72	N87-26038
1100 1100	p 73 p 56	N87-27712 A87-33573
NSG-1490 N00014-84-C-0149	p 58	A87-39958
N00014-85-C-2200	p 140	N87-21991 N87-26180
PRF-17006-AC5-C W-7405-ENG-48	p 108 p 171	N87-22697
186-30-21	p 128	N87-20841
	p 129 p 129	N87-22570 N87-22571
199-13-46-1	p 120	N87-24162
199-61-12	p 130	N87-25767
199-99-00-00-72 481-01-02	р 53 р 97	N87-27392 N87-25422
481-02-02	p 93	N87-20378
	р 96 р 98	N87-24536 N87-26135
481-32-23-01	p 65	N87-21994
481-51-02	p 80	N87-26144
481-52-02481-54-02	р 107 р 96	N87-25480 N87-22001
401.04.02	p 78	N87-22004
482-52-21	p 68 p 165	N87-23690 N87-21585
482-53-53-38		N87-21020
482-58-19-02	p 117	N87-29167
483-31-03-01483-32-03-02	p 103 p 140	N87-29593 N87-20795
485-40-02	p 78	N87-23695
505-41-5A	p 79 n 44	N87-23696 N87-20353
505-63-11-01	p 40	N87-29899
505-67-51	p 171	N87-25760 N87-25838
506-00-00506-41-11		N87-23028
506-41-21		N87-24838
	p 79	4.0- 00044
	p 79 p 5	N87-29914 N87-22003
506-41-31	p 79 p 5	N87-29914 N87-22003 N87-22174
	p 79 p 5 p 96 p 78 p 63	N87-22003 N87-22174 N87-20477
506-41-31	p 79 p 5 p 96 p 78 p 63 p 96	N87-22003 N87-22174 N87-20477 N87-22237
506-41-31	p 79 p 5 p 96 p 78 p 63 p 96 p 96 p 141	N87-22003 N87-22174 N87-20477 N87-22237 N87-23821 N87-26173
506-41-31	p 79 p 5 p 96 p 78 p 63 p 96 p 96 p 141	N87-22003 N87-22174 N87-20477 N87-22237 N87-23821 N87-26173 N87-26085
506-41-31	p 79 p 5 p 96 p 78 p 96 p 96 p 96 p 141 p 37 p 28 p 10	N87-22003 N87-22174 N87-20477 N87-22237 N87-23821 N87-26073 N87-26085 N87-20567 N87-24709
506-41-31	p 79 p 5 p 96 p 78 p 96 p 96 p 96 p 141 p 27 p 28 p 10	N87-22003 N87-22174 N87-20477 N87-22237 N87-23821 N87-26173 N87-26085 N87-20567 N87-24709 N87-20339
506-41-31	p 79 p 5 p 96 p 78 p 96 p 96 p 96 p 141 p 37 p 28 p 10 p 86 p 96	N87-22003 N87-22174 N87-20477 N87-22237 N87-23821 N87-26073 N87-26085 N87-20567 N87-24709
506-41-31	p 79 p 5 p 96 p 78 p 96 p 96 p 96 p 141 p 97 p 28 p 10 p 86 p 98 e 10 p 98 e 10 p 98 e 10 p 98 e 10 e 10 e 10 e 10 e 10 e 10 e 10 e 10	N87-22003 N87-22174 N87-22477 N87-22237 N87-23821 N87-26173 N87-26085 N87-20567 N87-20359 N87-22949 N87-20352 N87-21021
506-41-31	p 79 p 5 p 96 p 78 p 96 p 96 p 96 p 141 p 37 p 28 p 10 p 186 p 10 p 196 p 10 p 196 p 10 p 196 p 10 p 196 p 10 p 10 p 10 p 10 p 10 p 10 p 10 p 10	N87-22003 N87-22174 N87-22477 N87-22237 N87-23821 N87-26173 N87-26085 N87-20567 N87-24709 N87-20339 N87-2939 N87-2939 N87-2939
506-41-31	p 79 p 5 p 96 p 78 p 63 p 96 p 9141 p 37 p 28 p 10 p 96 p 96 p 96 p 96 p 96 p 96 p 96 p 96	N87-22003 N87-22174 N87-22477 N87-23821 N87-23821 N87-26085 N87-20567 N87-24709 N87-2039 N87-22949 N87-20352 N87-21021 N87-29594 N87-20342 N87-20342
506-41-31	p 79 p 5 p 96 p 763 p 96 p 96 p 141 p 27 p 28 p 10 p 126 p 96 p 96 p 126 p 96 p 96 p 126 p 126	N87-22003 N87-22174 N87-22477 N87-22237 N87-23821 N87-26173 N87-26085 N87-204709 N87-20339 N87-22339 N87-20339 N87-2035 N87-21021 N87-2055 N87-21021 N87-20340
506-41-31	p 79 p 5 p 96 p 78 p 96 p 96 p 96 p 141 p 28 p 10 p 10 p 10 p 126 p 154 p 165 p 165 p 168	N87-22003 N87-22174 N87-22477 N87-22237 N87-23821 N87-26085 N87-2567 N87-24709 N87-20339 N87-22949 N87-20352 N87-21021 N87-20342 N87-20342 N87-20344 N87-20346 N87-20346 N87-20346 N87-20346 N87-20346 N87-20346 N87-20346
506-41-31	P 79 P 5 P 96 P 78 P 96 P 96 P 141 P 27 P 28 P 10 P 26 P 96 P 96 P 96 P 96 P 96 P 96 P 96 P 9	N87-22003 N87-22174 N87-22477 N87-2237 N87-23821 N87-26173 N87-26085 N87-20470 N87-20339 N87-20339 N87-20339 N87-20340 N87-2035 N87-21021 N87-20340 N87-20340 N87-20340 N87-20340 N87-21141 N87-20340 N87-21141
506-41-31	P 79 P 5 P 96 P 78 P 96 P 96 P 94 P 10 P 96 P 28 P 10 P 96 P 96 P 96 P 96 P 96 P 126 P 126 P 126 P 126 P 136 P 136 P 145 P 145 P 146 P 146	N87-22003 N87-22174 N87-22477 N87-22237 N87-23821 N87-26085 N87-2567 N87-24709 N87-20339 N87-22949 N87-20352 N87-21021 N87-20342 N87-20342 N87-20344 N87-20346 N87-20346 N87-20346 N87-20346 N87-20346 N87-20346 N87-20346

# REPORT NUMBER INDEX

# SPACE STATION SYSTEMS / A Bibliography (Supplement 6)

**JULY 1988** 

#### **Typical Report Number** Index Listing



Listings in this index are arranged alpha-numerically by report number. The page number indicates the page on which the citation is located. The accession number denotes the number by which the citation is identified. An asterisk (\*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

A-86037		***************************************		D 52	NA	-2406	4 * #
		***************************************		D 129		-2257	
		•		128		-2084·	
		•••••		129		-2004 '-2257(	•
		·····		171		-225760 -25760	
			,	,,,,	1407	-23/00	, #
AAC-TN-115	50-REV-/	٠	ţ	35	N87	-25349	* #
AAS PAPER	86-001			55	A87	-32727	
AAS PAPER				13		-32729	
AAS PAPER			. į	55	A87	-32730	)
AAS PAPER			. p	56	A87	-32732	•
AAS PAPER				133	A87	32733	٠
AAS PAPER			. p	56	A87	32736	•
AAS PAPER			. p	56	A87	32741	
AAS PAPER			. p	133	A87	32743	
AAS PAPER			. p	133	A87	32744	•
AAS PAPER	86-043		. p	99	A87-	32745	•
AAS PAPER			. p	99		32746	•
AAS PAPER			. p	75	A87-	32747	*
AAS PAPER			. p	170	A87-	53083	
AAS PAPER			. p	170	A87-	53085	
AAS PAPER			Ď	2	A87-	53086	
AAS PAPER			Ď	165		53089	
AAS PAPER		•••••	P	123	A87-	38568	•
AAS PAPER		************************	р	89	A87-	38569	•
AAS PAPER			P	123	A87-	38570	
AAS PAPER			p	123	A87-	38571	•
AAS PAPER			р	89	A87-	38572	•
AAS PAPER		•••••	р	124	A87-	38573	
AAS PAPER	86-244		P	124	A87-	38574	*
ACSC-87-142	25	•••••	р	171	N87-	25815	#
AD-A175224			D	29	N87-	20574	#
AD-A175529			•	26		20355	#
AD-A176722		******************		170		21753	#
AD-A176815				140		21024	#
AD-A176820			•	29		21025	#
AD-A176998		***************************************	•	29		21030	#
AD-A177106		***************************************		29		21388	#
AD-A177168			p.		N87-2		#
AD-A177271		***************************************	p:		N87-2		#
AD-A177512	************			140	N87-2		#
AD-A177795			p:		N87-2		#
AD-A178578		******************	pi		N87-2		#
AD-A178870	***************************************		p		N87-2		#
AD-A178997		••••••••••		120	N87-2		#
AD-A179106		***************************************		161	N87-2		#
AD-A179183	**********	•••••		140	N87-2		#
AD-A179205				129			
		***************************************	P	129	N87-2	2/56	#

..... p 68

N87-23682

N87-23683

..... р 137

AD-A179233 ......

AD-A179235 ..

AD-A179241 ....

AD-A179459 .....

AD-A179711			_	70 107 0000	
		•			
AD-A179726		•••••••	р	35 N87-24517	
AD-A179873			р	171 N87-25815	
AD-A179989			•		
AD-A180276					
					i
AD-A180606		••••••			j
AD-A180831	********		p 1	172 N87-26964	1
AD-A181488			p 1	72 N87-26966	i
AD-A181531					,
AD-A181735					
AD-A181798					1
				03 N87-26968	*
AD-A181962		•••••			
AD-A182589			р 8	31 N87-28186	#
AD-A182605		•••••	р 4	6 N87-29217	#
AD-A182623			D 1	10 N87-27809	#
AD-A182796					
AD-A182931					ħ
AD-A183302					Ħ
		•••••••			Ħ
AD-A185880	************		p 1	42 N87-26937	#
AD-D012559			р9	3 N87-20375	
AFGL-TR-86-0	214 .		p 1	40 N87-23678	#
AFGL-TR-87-0	1042		p .	21 107-20070	
711 GE-111-07-0		• • • • • • • • • • • • • • • • • • • •	P 1	31 N87-26967	#
ACIT/OL/ND o					
AFIT/CI/NR-8	7-191	***************************************	р 1	70 N87-21753	#
AFIT/GA/AA/	86D-2		p6	8 N87-23681	#
AFIT/GA/AA/	86D-5				#
		***************************************	P 1	LO 1107-22730	#
AEIT/GE/ENG	1000	**	- 0		
AFIT/GE/ENG	1/000	·41	ры		#
AFIT/GE/ENG	i/8/J-	2	р 8	1 N87-28186	#
AFIT/GNE/EN	IP/87N	<i>I</i> I-1	p 40	N87-29217	#
					"
AFIT/GSO/AA	/86D-	2	n 14	S1 N87-23677	
AFIT/GSO/AA					#
AI II / GOO/AA	, 00D-	5	рз	N87-23680	#
A F.IT (000 (F)					
AFIT/GSO/EN	G/86	D-1	p 12	20 N87-22762	#
AFIT/GSO/EN	S/86D	)-3	p 13	7 N87-23682	#
					π
AFOSR-87-001	3TD		- 00	NO7 04000	
AFOSR-87-002					#
					#
AFOSR-87-016					#
AFOSR-87-016			p 30	N87-22252	#
AFOSR-87-017	6TPI.		p 11	0 N87-27809	#
AFOSR-87-027	9TR .		p 30		#
AFOSR-87-028					#
AFOSR-87-040		••••••			
AFOSR-87-042					#
AFOSR-87-050					#
AFOSR-87-056				N87-24517	#
		••••••			#
AFOSR-87-071			. р 38	N87-27259	#
AFOSR-87-0956	BTR		. p 11	N87-29893	#
AFWAL-TR-87-4	4010.		. p 110	N87-28584	#
					11
AGARD-CP-397	• • • • • • • • • • • • • • • • • • • •		. p 26	N87-20355	#
AGARD-CP-406			D 141	2 N87-26937	
3, 400			. p 14,	- 1407-2093/	#
AIAA PAPER 85				407 //0//	
AIAA PAPER 87			. p 7	A87-41611 *	#
		***************************************			#
AIAA PAPER 87				A87-33658 *	#
AIAA PAPER 87			р6		#
AIAA PAPER 87					#
AIAA PAPER 87	-0720				#
AIAA PAPER 87		***************************************			π #
AIAA PAPER 87			•		
AIAA PAPER 87					#
AIAA PAPER 87	0740	***************************************		7.07 00000	#
					#
AIAA PAPER 87	-0/45	••••••			#
AIAA PAPER 87			p 16	A87-33670 *	#
AIAA PAPER 87		***************************************		• • • • · · · · ·	#
AIAA PAPER 87	-0782				#
AIAA PAPER 87					
AIAA PAPER 87					#
					#
AIAA PAPER 87		••••••		A87-33591 #	ŧ
AIAA PAPER 87-			p 19		ŧ
AIAA PAPER 87-	-0821				ŧ
AIAA PAPER 87-	0823			A87-33610 * #	
AIAA PAPER 87-	0824				
AIAA PAPER 87-					
VIII EN 0/-	JU20		p 14	A87-33613 * #	F

AIAA PAPER 87-086	9 -1	4 407 0000
AIAA PAPER 87-086	_ '	
AIAA PAPER 87-087		
AIAA PAPER 87-087		
	·	
AIAA PAPER 87-087		
AIAA PAPER 87-087		
AIAA PAPER 87-088	7 p 1	6 A87-33706
AIAA PAPER 87-089		
AIAA PAPER 87-089	1p5	8 A87-39644
AIAA PAPER 87-089.	2p1	7 A87-33709
AIAA PAPER 87-089	5p 10	
AIAA PAPER 87-090	) p 50	
AIAA PAPER 87-090	1 p 19	
AIAA PAPER 87-090:		
AIAA PAPER 87-090:		
AIAA PAPER 87-0904		
AIAA PAPER 87-0905		
AIAA PAPER 87-0925		
AIAA PAPER 87-0927		
AIAA PAPER 87-0930		A87-33728
AIAA PAPER 87-0931	, P C.	
AIAA PAPER 87-0939		
AIAA PAPER 87-0940		
AIAA PAPER 87-0940		
AIAA PAPER 87-0943	,	
AIAA PAPER 87-0944		
AIAA PAPER 87-0949	p 10	
AIAA PAPER 87-0959	p 18	A87-33751
AIAA PAPER 87-0961	р 18	
AIAA PAPER 87-0964	p 19	
AIAA PAPER 87-0985	p 88	
AIAA PAPER 87-0988	p 12	
AIAA PAPER 87-0989	р 88	A87-38003
AIAA PAPER 87-0990	p 89	A87-38004
AIAA PAPER 87-0994	p 58	A87-41103
AIAA PAPER 87-1031	p 89	A87-38015
AIAA PAPER 87-1036		
AIAA PAPER 87-1040	·	A87-41122 A87-39628
AIAA PAPER 87-1041		
AIAA PAPER 87-1042	•	A87-39629
AIAA PAPER 87-1102	p 89	A87-38016
AIAA PAPER 87-1468	p 76	A87-41145
	р 43	A87-43003
AIAA PAPER 87-1469	р 77	A87-43004
AIAA PAPER 87-1482	p 43	A87-43014
AIAA PAPER 87-1498	p 90	A87-43027
AIAA PAPER 87-1505	p 160	A87-43031
AIAA PAPER 87-1522	p 44	A87-44830
AIAA PAPER 87-1525	p 43	A87-43048
AIAA PAPER 87-1537	p 43	A87-43059
AIAA PAPER 87-1540	p 44	A87-44843
AIAA PAPER 87-1543	p 135	A87-43060
AIAA PAPER 87-1559	p 90	A87-44832
AIAA PAPER 87-1599	p 43	A87-43103 1
AIAA PAPER 87-1623	p 52	A87-43122
AIAA PAPER 87-1627	p 44	A87-43125 1
AIAA PAPER 87-1628	p 44	A87-43126 '
AIAA PAPER 87-1672	p 100	A87-41152
AIAA PAPER 87-1677	p 100	
AIAA PAPER 87-1763	p 90	A87-45190
AIAA PAPER 87-1764	p 92	A87-48572 1
AIAA PAPER 87-1767	p 91	A87-45191 1
AIAA PAPER 87-1768	p 135	A87-45192
AIAA PAPER 87-1775	p 91	A87-45196
AIAA PAPER 87-1858	p 91	A87-45255 *
AIAA DADED OZ 1000	p 91	A87-45256 1
ALAA DADED OF 1000	p 152	A87-45257
ALAA DADED OF LOCA	p 132	A87-45258
ALAA DADED OF LOOK		
ALA DADED OF LOCK	p 91	A87-45259 *
ALAA DADED OF ASSE	p 91	A87-45260
ALAA DADED OT 4004	p 91	A87-45287
4144 04555 45 45 45	p 92	A87-45311
ALAA DADED AT AALA	p 93	A87-52247 *
ALAA DADED OF COOL	p 92	A87-45357
	р 92	A87-45360
	р 77	A87-45363
AIAA PAPER 87-2120	р 93	A87-50197 *
	р 62	A87-52252 *
AIAA PAPER 87-2155 .	p 92	A87-45439
	p 160	A87-45441
4144 54555	р 153	A87-48578
414 4 D 4 D 9 D	p 153	A87-48579
*** *		
	_ 450	
ALA A DADED OF COS	p 153	A87-48580
ALA A DADED OF COS	p 153	A87-48580 A87-48581

## **AIAA PAPER 87-2196**

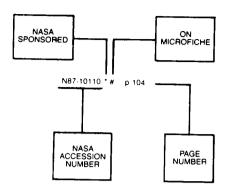
AMA PARENT 872197 9139 A87-48652 9 DOLL PROFITS 87.7 9139 A87-48197 POST TAR 85-061 VICL. 1 9130 A87-48197 POST TAR 85-061 VICL. 2 9130 A87-48197 POST TAR 85-061 VICL. 2 9130 A87-48197 POST TAR 85-061 VICL. 3 9130	AIAA PAPER 87-219	õ								
AMA PAREN 87-2109					5.57	AR7-36762	FTN-87-99995	p 97	N87-26058 #	
AMA PAPER 87-2292	AIAA PAPER 87-2196	p 119	A87-48582 * #	DGLR PAPER 86-172	p 57		2			
AMA PAPER 87-2029	AIAA PAPER 87-2197	р 113	A87-48583 #				FOK-TR-R-86-091-VOL-1	p 102	N87-25336 #	
AMA PAPER 87-2029	AIAA PAPER 87-2199	p 154	A87-48585 #	DPD-665-VOI -1	р 131	N87-29585 * #	FOK-TR-R-86-091-VOL-2	p 102	N87-24486 #	
AMA PAPER 87-2207   154 A27-4802   7   108-3050-1   7   1	AIAA PAPER 87-2202	p 113	A87-48587 #				FOK-TR-R-86-091-VOL-3	p 102	N87-25337 #	
AMA PAPER 87-2200 p.114 AR7-48930 # p.10-0.05650-1 p.25 NB-72888 # FSR-CRIT-LS-VOL.2 p.77 NB-72 AMA PAPER 87-2200 p.114 AR7-4893 # p.10-0.05650-2 p.39 NB-72888 # FSR-CRIT-LS-VOL.2 p.79 NB-72 NB-72 AMA PAPER 87-2200 p.154 AR7-4893 # p.10-0.05650-2 p.39 NB-72888 # FSR-CRIT-LS-VOL.2 p.79 NB-72 AMA PAPER 87-2201 p.154 AR7-4893 # p.10-0.05650-2 p.14 NB-72893 # FSR-CRIT-LS-VOL.2 p.17 NB-72 AMA PAPER 87-2217 p.114 AR7-4893 # FSR-CRIT-LS-VOL.2 p.18 NB-72893 # P.18 AR7-4893 # P.19 NB-72893 # P.19 N	AIAA PAPER 87-2203	n 113	A87-48589 * #	DR-4-VOL-1	р 131	N87-29585 * #		n 79	N87-23695 * #	
AAA APER 87-2207	AIAA DADED 87-2204	p 113	A87-48590 #			NO7 00504 * #	FSR-DR-15-VOL-1		N87-23696 * #	
AAA APER 87-2200	AIAA PAPER 87-2207	p 154	A87-48592 #	D180-30550-1	p 39			•		
AAA PAPER 87-2200 p. 166	AIAA PAPER 87-2208	p 114	A87-48593 * #				FTMS-RPT-006	p 97	N87-26058 #	
AMA PAPER 87-2213	AIAA PAPER 87-2209	p 169	A87-48594 * #							
AAA PAPER 87-221   2-1	AIAA PAPER 87-2210	p 154		5400 10000 · ·····	•		GAO/IMTEC-87-20	. p 137	N87-22551 #	
ANA PAPER 97-227   0.114 ABT-48600 *   E-5410   0.29	AIAA PAPER 87-2211	n 110						n 07	N87-26081 * #	
AAAA PAPER 87-2227	AIAA DADED 87-2217	p 114		E-3410	p 96		GDSS-CHAD-87-004	. p 3/	1407-20001 #	
AAA PAPER 87-2222   114	AIAA PAPER 87-2219	p2		E-3463	p 97		GDSS-SP-86-011-VOL-1A	. p 161	N87-21018 * #	
AIAA PAPER 97-2229	AIAA PAPER 87-2221	р7								
AMA PAPER 87-2239	AIAA PAPER 87-2227			E-3510	p 44		GE-DOC-87SDS-024	. р9	N87-21995 * #	
ANA PAPER 87-2248	AIAA PAPER 87-2228			E-3511	р 165			n 171	N87-25024 #	
AIAA PAPER 97-2249	AIAA PAPER 87-2238	р 60		E-3521	p 96		GPO-59-356			
AAAA PAPER 87-2289	AIAA PAPER 87-2248	p 7		E-3527	p 63		GPO-73-418	p 171	N87-22560 #	
AMA PAPER 87-2250 p. 60 A37-30415 # E-3569 p. 73 N87-22114 # H-REPT-100-2064 p. 171 N87-2 AIAA PAPER 87-2250 p. 22 A87-50416 * # E-3567 p. 96 N87-22001 * # AIAA PAPER 87-2252 p. 23 A87-50416 * # E-3569 p. 77 N87-25020 * # AIAA PAPER 87-2252 p. 23 A87-50416 * # E-3569 p. 77 N87-25020 * # AIAA PAPER 87-2252 p. 23 A87-5042 # E-3690 p. 78 N87-2204 * # AIAA PAPER 87-2322 p. 23 A87-5042 # E-3690 p. 78 N87-2204 * # AIAA PAPER 87-2322 p. 23 A87-5044 # E-3690 p. 78 N87-2204 * # AIAA PAPER 87-2325 p. 24 A87-5044 # E-3690 p. 96 N87-2204 * # AIAA PAPER 87-2252 p. 24 A87-5044 # E-3690 p. 96 N87-2381 * # AIAA PAPER 87-2252 p. 24 A87-5044 # E-3690 p. 96 N87-2381 * # AIAA PAPER 87-2252 p. 24 A87-5044 # E-3690 p. 96 N87-2381 * # AIAA PAPER 87-2390 p. 96 N87-2404 * # E-3690 p. 96 N87-2381 * # AIAA PAPER 87-2390 p. 96 N87-2404 * # E-3690 p. 96 N87-2381 * # AIAA PAPER 87-2390 p. 96 N87-2404 * # E-3690 p. 96 N87-2400 * # AIAA PAPER 87-2390 p. 96 N87-2400 * # AIAA PAPER 87-2490 p. 97 N87-2500 * # AIAA PAPER 87-2490 p. 97 N87-2500 * # AIAA PAPER 87-2490 p. 98 N87-2500 p. 98 N87-2400 * # AIAA PAPER 87-2490 p. 98 N87-2500 * # AIAA PAPER 87-2500 p. 98 N87-2500 * # AIAA PAPER 87-2500 p. 98 N87-2500 * # AIAA PAPER 87-2500 p. 98 N87-2500 * # AIAA PAPER 87-2	AIAA PAPER 87-2249	р 60		E-3531	p 96					
AMA PAPER 97-2253 D 86 A87-0417 # E-3509 D 75 N87-22030 * # IAF PAPER 86-182 D 90 A87-0417 # E-3509 D 75 N87-22030 * # IAF PAPER 86-182 D 90 A87-0417 # E-3509 D 75 N87-22030 * # IAF PAPER 86-182 D 90 A87-0417 # E-3509 D 96 N87-22030 * # IAF PAPER 86-182 D 90 N87-22030 * # IAF PAPER 87-22030 * # IAF PAP	AIAA PAPER 87-2250	р 60		E-3569	р 78		H-REPT-100-204	. p 171	N87-25024 #	
AIAA PAPER 87.2232 P. 23 A87-50447 # E-3560 P. 78 N87-2020 * # IAF-86-212 P. 23 A87-50447 # E-3561 P. 96 N87-2020 * # IAF-86-212 P. 23 A87-50448 # E-3562 P. 78 N87-2020 * # IAF-86-312 P. 23 A87-50448 # E-3562 P. 78 N87-2020 * # IAF-86-312 P. 23 A87-50448 # E-3562 P. 78 N87-2020 * # IAF-86-312 P. 23 A87-50448 # E-3562 P. 78 N87-2020 * # IAF-86-312 P. 24 A87-50448 # E-3562 P. 96 N87-2020 * # IAF-86-312 P. 24 A87-5044 # E-3564 P. 97 N87-2542 P. IAF-87-234 P. 80 N87-2020 * IAF-86-312 P. 10 N87-2020 * IAF-86-312 P. IAF-	AIAA PAPER 87-2251	p 60		E-3577	р 96			- 00	A87-42680	
ANA PAPER 87-3221 D 23 A87-50429 # E-SS91 D 56 N87-22040 # IA-F86-232 D 23 A87-50449 # E-SS92 D 78 N87-22040 # IA-F86-38 D 121 N87-24AAA PAPER 87-3224 D 23 A87-50446 # E-SS92 D 68 N87-22090 # IA-F86-38 D 121 N87-24AAA PAPER 87-3224 D 24 A87-50446 # E-SS92 D 68 N87-22090 # IA-F86-38 D 121 N87-24AAA PAPER 87-3224 D 24 A87-50446 # E-SS92 D 68 N87-22090 # IA-F86-38 D 121 N87-24AAA PAPER 87-3292 D 128 A87-50471 # E-SS67 D 104 N87-25291 # IA-F86-38 D 121 N87-24AAA PAPER 87-2393 D 24 A87-50471 # E-SS67 D 104 N87-25490 # IA-F86-38 D 11 N87-25490 # IA-F86-39 D 120	AIAA DADED 87-2252	p 86		E-3590	p 79		IAF PAPER 86-162	. р эо	A81-42000	
AAAA PAPER 87-2322	AIAA PAPER 87-2321	p 23		E-3591	p /8		IAE-86-212	в 30	N87-22269 #	
AAA APACER 87-2322   D 23 A87-50446   E 3-869   D 78 N87-23692   M 1AF-58-81   D 730 N87-2404   AAA APACER 87-2322   D 24 A87-50406   E 3-869   D 78 N87-23692   M 1AF-57-234   D 80 N87-24049   AAA APACER 87-2387   D 128 A87-50471   E 3-656   D 80 N87-28187   M 1AF-57-259   D 98 N87-28187   M 1AF-57-259   D 128 A87-50471   E 3-656   D 128 N87-28187   M 1AF-57-259   D 128 N87-28187   M 1AF-59-590   M 1	AIAA PAPER 87-2322	p 23					IAF-86-38	p 121	N87-26841	
AAAA PARER 87-2322	AIAA PAPER 87-2323	p 23		F-3629	p 68		IAF-86-81	р 130	N87-25506	
ALA PAPER B7-2387	AIAA PAPER 87-2324	p 24		E-3648	р 97		IAF-87-234	р 80	N87-26144 * #	
AlAA PAPER 87-2387	AIAA PAPER 87-2325	p 24		E-3649	р 98		IAF-87-259	p 98	N87-26135 * #	
AIAA PAPER 87-2888	AIAA DADED 87-2320	n 24		E-3657	р 96		104 CE 90 DE	n 11	N87-30107 * #	
AIAA PAPER 87-2890   0.24 A87-503-07 # E1-278-815   0.8 N87-21020 "# IIIT-M06124-F   0.910 N87-2	AIAA PAPER 87-2388	p 61	A87-50472 #	E-3669	p 107					
AIAA PAPER 87-2391	AIAA PAPER 87-2389	р 24		E-3692	p 60	1407-20144 #	IITRI-M06124-F	p 110	N87-28584 #	
AIAA PAPER 97-2865   p. 24	AIAA PAPER 87-2390	р 61		FL278-R518	р8	N87-21020 * #				
AMA PAPER 87-2457	AIAA PAPER 87-2391	p 61					ILR-MITT-168	р 79	N87-24532 #	
AMA PAPER 87-2455	AIAA PAPER 87-2456	p 24		EMSB-64/85	р 35	N87-24516 #		- 26	N87-20355 #	į
AIAA PAPER 87-2469	AIAA DADED 87-2458	n 24				NO7 04514 #	ISBN-92-835-0396-1	p 20	N87-26937 #	
AIAA PAPER 87-2460	AIAA PAPER 87-2459	p 61	A87-50505 * #	ESA-CR(P)-2313-VOL-1	p /0					
AIAA PAPER 87-2461	AIAA PAPER 87-2460	p 25		ESA-CR(P)-2313-VOL-2	р 69		ISSN-0379-6566	p 128	N87-20621 #	
AIAA PAPER 87-2586	AIAA PAPER 87-2461	p 25		FSA-CR(P)-2316	p 115		ISSN-0379-6566	p 81	N87-28959 #	
AIAA PAPER 87-2528	AIAA PAPER 87-2464	p 93		ESA-CR(P)-2319	р 79	N87-24533 #	ISSN-079-6566	р 171	N87-25354 #	
AIAA PAPER 87-2530	AIAA DADER 87-2528	p 62		ESA-CR(P)-2329	р 35		IDI DI ID 96 47	n 79	N87-25838 * #	ŧ
AIAA PAPER 87-2565   p.92 AB7-49817 # ESA-CRIP)-2346-VOL-1   p.102 N87-25336 # JPRS-USP-86-004   p.158 N87- AIAA PAPER 87-2566   p.136 AB7-49817 # ESA-CRIP)-2346-VOL-2   p.102 N87-24536 # JPRS-USP-86-004   p.158 N87- AIAA PAPER 87-2568   p.128 AB7-50558 # ESA-CRIP)-2346-VOL-3   p.102 N87-28230 # L.16163   p.28 N87- AIAA PAPER 87-2599   p.62 AB7-50558 # ESA-CRIP)-2348   p.97 N87-28250 # L.16242-PT-2   p.34 N87- AIAA PAPER 87-2599   p.62 AB7-50558 # ESA-CRIP)-2348   p.97 N87-28538 # L.16242-PT-2   p.34 N87- AIAA PAPER 87-2601   p.61 A87-50486 # ESA-CRIP)-2348   p.97 N87-24530 # L.16242-PT-2   p.34 N87- AIAA PAPER 87-2601   p.61 A87-50486 # ESA-CRIP)-2348   p.97 N87-24530 # L.16242-PT-2   p.34 N87- AIAA PAPER 87-2601   p.61 A87-50486 # ESA-CRIP)-2351-VOL-1   p.73 N87-27706 # L.C-86-600569   p.171 N87- AIAA-87-9933   p.96 N87-22237 # ESA-CRIP)-2351-VOL-1   p.73 N87-27708 # L.MSC-F177633   p.35 N87- AIAA-87-9033   p.96 N87-22247 # ESA-CRIP)-2361-VOL-1   p.73 N87-27708 # L.MSC-F177633   p.35 N87- AIAA-87-9030   p.96 N87-22249 # ESA-CRIP)-2361-VOL-1   p.73 N87-27708 # L.MSC-F177633   p.35 N87- AIAA-87-9030   p.96 N87-22249 # ESA-CRIP)-2361-VOL-1   p.73 N87-27708 # L.MSC-F177633   p.35 N87- AIAA-87-9030   p.96 N87-22249 # ESA-CRIP)-2363   p.115 N87-2555 # L.P-RP-AL-204-VOL-1   p.70 N87- AIAA-87-9035   p.78 N87-22001 # ESA-CRIP)-2365   p.115 N87-2555 # L.P-RP-AL-204-VOL-1   p.68 N87- AIAA-87-9257   p.68 N87-22001 # ESA-CRIP)-2365   p.171 N87-2555 # M.544-VOL-1   p.68 N87- AIAA-87-9257   p.68 N87-22004 # ESA-SP-256   p.171 N87-2555 # M.544-VOL-1   p.68 N87- AIAA-87-9257   p.68 N87-22004 # ESA-SP-256   p.171 N87-2555 # M.544-VOL-1   p.68 N87-22004 # ESA-SP-266   p.128 N87-20621 # M.554-VOL-3   p.68 N87-22004 # ESA-SP-266   p.128 N87-20621 # M.554-VOL-3   p.68 N87-22004 # ESA-SP-266   p.128 N87-20621 # M.554-VOL-3   p.101 N87-22503 # ETN-87-90467   p.116 N87-28556 # M.88-UP-E-907-86-PUB   p.154 N87-20666   p.158 N87-	AIAA PAPER 87-2530	p 161		ESA-CR(P)-2338	p 158		JPL-PUB-80-47	p 141		
AIAA PAPER 87-2567	AIAA PAPER 87-2565	p 92	A87-49615 " #	ESA-CR(P)-2346-VOI -1	p 30					
AIAA PAPER 87-2596   D. 22	AIAA PAPER 87-2567	р 93	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	FSA-CR(P)-2346-VOL-2	p 102		JPRS-USP-86-004	p 158	N87-27687 #	ŧ
AIAA PAPER 87-2589	AIAA PAPER 87-2568	p 136		ESA-CR(P)-2346-VOL-3	p 102	2 N87-25337 #			N87-20567 * #	
AIAA PAPER 87-2801	AIAA DADED 87-2599	p 62		ESA-CR(P)-2347	p 103	3 N87-28260 #	L-16163	p 28	N87-24495 * #	
AIAA PAPER 87-2641	AIAA PAPER 87-2600	p 62		FSA-CR(P)-2348	р9/	N87-26058 #	L-16242-P1-2	р эч	1107-24400 #	
AIAA-87-0993	AIAA PAPER 87-2641	р 61	A87-50486 #	ESA-CR(P)-2355	p /9		LC-86-600569	р 171	I N87-21754 #	ŧ
AIAA-87-09994   p 63 N87-20477				ESA-CR(P)-2361-VOL-1	р 73					
AIAA-87-1764	AIAA-87-0993	p 96		ESA-CR(P)-2361-VOL-2	р 73	N87-27708 #	LMSC-F177633	р 36	N87-25606 * #	ŧ
AIAA-87-2120	AIAA-87-0994	p 63		ESA-CR(P)-2361-VOL-4	р73	N87-27709 #		- 70	N87-24514 #	#
AIAA-87-9003	AIAA-87-1704	p 96		ESA-CR(P)-2362	p 11		LP-RP-AI-204-VOL-1	p / 0	N87-24490 #	
AIAA-87-9035	AIAA-87-9003	p96	N87-22001 * #	ESA-CR(P)-2363	p 11:		LP-RP-AI-204-VOL-2	р 69	N87-24491	
AIAA-87-9257	AIAA-87-9035	р 78					Er - 111 - 711-204 102 0 1111111111111			
AIAA-87-9355	AIA A-97-9257	p /9		FSA-SP-255	р 17	1 N87-25354 #	M-548			
## SSA-SP-267	AIAA-87-9353	p 68		FSA-SP-266	p 12	8 N87-20621 #	M-554-PT-1	p 65	N87-22702 * # N87-22729 * #	
ASME PAPER 87-APM-34	AIAA-87-9355	р 76	1407-22004 #	ESA-SP-267	р 81	N87-28959 #	M-554-PT-2	р 66	N87-22129 1	7
ASME PAPER 87-APM-34	ASMF PAPER 86-GT-100	p 166	6 A87-25396 * #		n 01	NIQ7.28050 #	MATRA-RE/176/0932-ISS-1	p 11/	5 N87-28586	#
ATES-AN-86/466 p 79 N87-24530 # ETN-87-90462 p 73 N87-27706 # MBB-UD-489/86 p 30 N87 ETN-87-90463 p 73 N87-27707 # MBB-UD-492/86 p 107 N87 B-226577 p 137 N87-22551 # ETN-87-90464 p 73 N87-27709 # MBB-UD-492/86 p 107 N87 B-26577 p 137 N87-22551 # ETN-87-90465 p 73 N87-27709 # MBB-UR-E-907-86-PUB p 154 A87 B-26578 p 158 N87 B-26585 # MBB-UR-E-912/86 p 15	ASME PAPER 87-APM-34	p 59	A87-42505 #	ETN-87-9015/	poi n 38		MATTIA-TIT / TYO/ GOOD TOO 1 III.			
B-226577			1107.04500 #	FTN-87-90462	р 73		MBB-UD-489/86	р 30	N87-22269	#
B-226577 p 137 N87-22551 # ETN-87-90464 p 73 N87-27709 # MBB-UR-E-907-86-PUB p 154 A87 BAC-ER-18056-8 p 97 N87-24641 * # ETN-87-90466 p 115 N87-28585 # MBB-UR-E-912/86 p 158 N87 BNL-39695 p 99 N87-28405 # ETN-87-90467 p 138 N87-28586 # MBB-UR-E-921/86 p 158 N87 ETN-87-90467 p 138 N87-28586 # MBB-UR-E-921/86 p 158 N87 BNL-39695 p 99 N87-28405 # ETN-87-99672 p 138 N87-28586 # MBB-UR-E-922/86 p 158 N87 CONF-870102-23 p 99 N87-28405 # ETN-87-99672 p 79 N87-24532 # BTN-87-99868 p 170 N87-22534 # MBB-UR-E-923/86 p 121 N87 CONF-870148-1 p 101 N87-22231 # ETN-87-99868 p 76 N87-24534 # MBB-UR-873/86 p 190 N87 CONF-870162-1 p 171 N87-22597 # ETN-87-99869 p 68 N87-24490 # CONF-870354-2 p 102 N87-22233 # ETN-87-99869 p 68 N87-24490 # CONF-870354-2 p 102 N87-22233 # ETN-87-99870 p 69 N87-24491 # MCR-85-640 p 30 N87 CONF-870395-1 p 102 N87-22233 # ETN-87-99870 p 115 N87-26057 # CONF-870395-1 p 103 N87-22708 # ETN-87-99870 p 115 N87-24533 # MDC-W0070 p 120 N87 CONF-870395-1 p 103 N87-27408 # ETN-87-99881 p 35 N87-24516 # ETN-87-99881 p 35 N87-24516 # ETN-87-99881 p 102 N87-24486 #	ATES-AN-86/466	р /9	N87-24530 #	ETN-87-90463	p 73	N87-27707 #	MBB-UD-492/86	p 10	7 N87-25430 i	#
BAC-ER-18056-8 p 97 N87-24641 * # ETN-87-90466 p 115 N87-28585 # MBB-UR-E-912/86 p 158 N87 ETN-87-90467 p 115 N87-28586 # MBB-UR-E-921/86 p 158 N87 BNL-39695 p 99 N87-28405 # ETN-87-99434 p 128 N87-20621 # MBB-UR-E-923/86 p 121 N87 CONF-870102-23 p 99 N87-28405 # ETN-87-99672 p 179 N87-24532 # ETN-87-99868 p 170 N87-25354 # MBB-UR-873/86 p 121 N87 CONF-870148-1 p 101 N87-20231 # ETN-87-99868 p 170 N87-24514 # MBB-UR-873/86 p 130 N87 CONF-870148-1 p 171 N87-22697 # ETN-87-99868 p 170 N87-24514 # MBB-UR-873/86 p 190 A87 CONF-870162-1 p 171 N87-22697 # ETN-87-99869 p 68 N87-24490 # CONF-870354-2 p 102 N87-22233 # ETN-87-99870 p 69 N87-24491 # MCR-85-640 p 30 N87 CONF-870395-1 p 102 N87-22233 # ETN-87-99870 p 115 N87-26057 # CONF-870395-1 p 102 N87-22242 # ETN-87-99870 p 115 N87-26533 # MDC-W0070 p 120 N87 CONF-870391-3 p 103 N87-27408 # ETN-87-99881 p 35 N87-24516 # ETN-87-99881 p 35 N87-24516 # ETN-87-99881 p 102 N87-24486 # ETN-87-99887 p 102 N87-24486 #	D 226577	n 137	7 N87-22551 #	ETN-87-90464	р73	N87-27708 #	MODIUS F 007 06 BUS	n 15	4 AR7-400A7	#
BAC-ER-18056-8	B-2205//	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	ETN-87-90465	p 73		MBB-UH-E-907-86-PUB	p 15.	8 N87-26842	n
BNL-39695 p 99 N87-28405 # ETN-87-99471 p 138 N87-28588 # MBB-UR-E-922/86 p 158 N87  CONF-870102-23 p 99 N87-28405 # ETN-87-99672 p 171 N87-25354 # MBB-UR-873/86 p 130 N87  CONF-870147-1 p 101 N87-2271 # ETN-87-99868 p 70 N87-24514 # MBB-UR-873/86 p 130 N87  CONF-870148-1 p 101 N87-22774 # ETN-87-99868 p 70 N87-24514 # MBB-UR-873/86 p 90 A87  CONF-870162-1 p 171 N87-22697 # ETN-87-99869 p 68 N87-24490 #  CONF-870354-2 p 102 N87-22233 # ETN-87-99870 p 69 N87-24491 # MCR-85-640 p 30 N87  CONF-870355-1 p 102 N87-22242 * ETN-87-99872 p 115 N87-2657 #  CONF-870395-1 p 108 N87-24028 # ETN-87-99875 p 79 N87-24533 # MDC-W0070 p 120 N87  CONF-870591-3 p 103 N87-27408 # ETN-87-99881 p 35 N87-24486 #  ETN-87-99881 p 102 N87-25336 # MIT-SSL-1-87 p 72 N87	BAC-ER-18056-8	р 97	N87-24641 * #	ETN-87-90466	n 11		MRR-UR-E-912/86	p 15	8 N87-25340	#
BNL-39695 p 99 N67-28405 # ETN-87-99434 p 128 N87-20621 # MBB-UR-E-923/86 p 121 N87  CONF-870102-23 p 99 N87-28405 # ETN-87-99672 p 79 N87-24532 # ETN-87-99672 p 171 N87-25354 # MBB-UR-873/86 p 130 N87  CONF-870147-1 p 101 N87-22231 # ETN-87-99868 p 70 N87-24514 # MBB-UR-877-86-PUB p 90 A87  CONF-870162-1 p 171 N87-22697 # ETN-87-99869 p 68 N87-24490 # MBB-UR-877-86-PUB p 90 N87  CONF-870354-2 p 102 N87-22233 # ETN-87-99869 p 69 N87-24491 # MCR-85-640 p 30 N87  CONF-870395-1 p 102 N87-22232 # ETN-87-99872 p 115 N87-2657 # ETN-87-99875 p 79 N87-24533 # MDC-W0070 p 120 N87  CONF-8704101-1 p 68 N87-244028 # ETN-87-99886 p 75 N87-24516 # ETN-87-99886 p 102 N87-25336 # MIT-SSL-1-87 p 72 N87				ETN-87-90467	р 13		MRR-UR-F-922/86	p 15	8 N87-25418	#
CONF-870102-23	BNL-39695	p 99	N87-28405 #	ETN-87-99434	p 12		MBB-UR-E-923/86	p 12	1 N87-26841	
CONF-870147-1 p 101 N87-2231 # ETN-87-99862 p 171 N87-25354 # MBB-UR-873/86 p 130 N87 CONF-870148-1 p 101 N87-2231 # ETN-87-99869 p 0.68 N87-24490 # CONF-870162-1 p 171 N87-22697 # ETN-87-99869 p 0.68 N87-24490 # CONF-870362-2 p 102 N87-22233 # ETN-87-99870 p 0.69 N87-24491 # MCR-85-640 p 30 N87 CONF-870395-1 p 102 N87-22233 # ETN-87-99870 p 115 N87-26505 # MCR-85-640 p 30 N87 CONF-8704101-1 p 68 N87-24028 # ETN-87-99875 p 79 N87-24533 # MDC-W0070 p 120 N87 CONF-870591-3 p 103 N87-2408 # ETN-87-99886 p 102 N87-24451 # MCR-85-640 p 102 N87-24533 # MCR-85-640 p 102 N87-24533 # MCR-85-640 p 102 N87-24534 # MCR-85-640 p 102 N87-85-640 p 102 N87		n 00	NR7-28405 #	ETN-87-99672	p 79	N87-24532 #		- 40	0 NOT DEEDE	
CONF-870148-1	CONF-870102-23	n 10		ETN-87-99862	p 17	'1 N87-25354 #	MBB-UR-873/86	p 139	A87-42680	
CONF-870162-1 p 171 N87-22997 # ETN-87-99870 p 69 N87-24491 # MCR-85-640 p 30 N87 CONF-870354-2 p 102 N87-22233 # ETN-87-99870 p 115 N87-26057 # ETN-87-99875 p 79 N87-24533 # MDC-W0070 p 120 N87 CONF-8704101-1 p 68 N87-24028 # ETN-87-99875 p 35 N87-24516 # ETN-87-99887 p 102 N87-25336 # MIT-SSL-1-87 p 72 N87 CONF-870591-3 p 103 N87-27408 # ETN-87-99886 p 102 N87-25336 # MIT-SSL-1-87 p 72 N87 CONF-870591-3 p 104 N87-22231 # ETN-87-99887 p 105 N87-24486 #	CONF-870148-1	p 10		ETN-87-99868	p 70		MBB-UH-8//-86-PUB	р эо	A07-42000	
CONF-870354-2 p 102 N87-22232 # ETN-87-99872 p 115 N87-26057 # CONF-870395-1 p 102 N87-22242 # ETN-87-99875 p 79 N87-24533 # MDC-W0070 p 120 N87 CONF-870591-3 p 103 N87-27408 # ETN-87-99881 p 35 N87-24516 # ETN-87-99886 p 102 N87-25336 # MIT-SSL-1-87 p 72 N87 CONF-870591-3 p 104 N87-22231 # ETN-87-99887 p 105 N87-24486 #	CONF-870162-1	p 17°	1 N87-22697 #	ETN-87-99869	p 60		MCR-85-640	р 30	N87-21987 *	#
CONF-870395-1	CONF-870354-2	p 102	2 NB7-22233 #	ETN 07 00070	p 0a					
CONF-870591-3 p 103 N87-27408 # ETN-87-99881 p 35 N87-28516 # ETN-87-99886 p 102 N87-25336 # MIT-SSL-1-87 p 72 N87	CONF-870395-1	p 102		ETN 07 00075	p 79		MDC-W0070	p 12	0 N87-20351 *	#
ETN-87-99886	CONF-8704101-1	p 68		ETN-87-99881	р 35	NB7-24516 #	. WT 001 4 0T	_ 70	N87-25805	,
	CONF-8/0591-3	р ю.	Z. 400 W	ETN-87-99886	p 10	)2 N87-25336 #	MIT-SSL-1-87	p /2	1407-2000	11
	DE87-004616	p 10	1 N87-22231 #	ETN-87-99887	p 10		NAS 1 15-100102	p 79	N87-24838 *	#
DE87-004627	DF87-004627	p 10	11 N87-20774 #	ETN 07 00000	p 10					
DE87-005326	DF87-005326	p 10	)2 N87-22233 #		p 73		NAS 1.15:100110	р 98	N87-26135 *	
DE87-006467	DE87-006467	p 17	1 N87-22697 #	=======================================	p 10		NAS 1.15:100113	р96	N87-23821 *	
DE87-007012 p 130 N87-2506 NAS 1.15:100122 p 107 N87	DE87-007012	p 10.		ETN-87-99936	p 10	30 N87-25506	NAS 1.15:100122	p 10	7 N87-25480 ° N87-26144 °	
p 102 N87-27408 # ETN-87-99954	DE87-00/03/	p 00		ETN-87-99954	p 1	58 N87-25340 #	NAS 1.15:100140	p 80		
DEDT-009121	DE87-010060	p 99	N87-28405 #	ETN-87-99955	p 1	58 N87-25418 #	NAS 1.15:100300	p 35		
ETN-07-99907 p. 36 N87-26075 # NAS 1 15-100488 p. 103 N87				ETN-87-99987	ائ ب 1. b ا		NAS 1.15:100306	p 10		
DGLB PAPER 86-104	DGLR PAPER 86-104	р 88	A87-36756			-				
DGLR PAPER 86-122 p 101 A87-48156 ETN-87-99994 p 103 N87-26260 #	DGLR PAPER 86-122	p 10	)1 A87-48156	EIN-0/-99994	р п	υυ 1407-20200 π				

									3-339
NAS	1.15:86588	p 64	N87-21993 * #	NAS 1.26:181381	n 30	N87-29590 * #	NACA CD 101070	- 44	- NOT 0101-0 "
	1.15:86594		N87-24723 * #	NAS 1.26:181396			NASA-CR-181073 NASA-CR-181095		
	1.15:86856		N87-24064 * #	NAS 1.26:181413			NASA-CR-181128		
NAS	1.15:87820	p 129	9 N87-22457 * #	NAS 1.26:181414			NASA-CR-181130		
NAS	1.15:87826	p 115		NAS 1.26:181422		1 N87-29591 * #	NASA-CR-181156		
NAS	1.15:88957 1.15:89051	p 96	N87-24536 * # N87-23687 * #	NAS 1.26:4010			NASA-CR-181163	p 14	1 N87-26173 * #
	1.15:89068		N87-26085 * #	NAS 1.26:4068		N87-25606 * #	NASA-CR-181165		
	1.15:89072		N87-20055 # N87-20352 * #	NAS 1.26:4072		N87-24641 * #	NASA-CR-181202		
	1.15:89111			NAS 1.26:4075 NAS 1.26:4091		N87-21994 * #	NASA-CR-181221 NASA-CR-181253	. p 45	N87-27702 * #
NAS	1.15:89118	p 86	N87-20339 * #	NAS 1.26:4099		N87-26086 * # N87-29899 * #	NASA-CR-181287	. p /2	
NAS	1.15:89137	р 45	N87-21021 * #	NAS 1.55:2447-PT-2	. p 34	N87-24495 * #	NASA-CR-181381		N87-27712 * # N87-29590 * #
	1.15:89221			NAS 1.55:2460		N87-20665 * #	NASA-CR-181396	. p 13:	2 N87-29633 * #
	1.15:89285			NAS 1.55:2465		N87-21141 * #	NASA-CR-181413	. p 40	N87-29898 * #
	1.15:89286			NAS 1.55:2467-PT-1	p 65	N87-22702 * #	NASA-CR-181414	. р74	N87-29713 * #
NAS	1.15:89295 1.15:89355	p 79	N87-25838 * #	NAS 1.55:2467-PT-2	p 66	N87-22729 * #	NASA-CR-181422	. p 131	1 N87-29591 * #
NAS 1	1.15:89429-VOL-1	p 53	N87-27407 * # N87-22571 * #	NAS 1.55:2470			NASA-CR-4010		5 N87-21585 * #
NAS 1	1.15:89429-VOL-2	n 129	N87-22570 * #	NAS 1.55:2484		N87-29914 * #	NASA-CR-4068		N87-25606 * #
NAS 1	1.15:89436	. p 128	N87-20841 * #	NAS 1.60:2661		N87-20567 * #	NASA-CR-4072	. р 97	N87-24641 * #
	1.15:89459			NAS 1.60:2690 NAS 1.60:2710		N87-20380 * # N87-20568 * #	NASA-CR-4075	. p 65	N87-21994 * #
NAS 1	1.15:89847	. р 93	N87-20378 * #	(VIO 1.00.E) 10	. p 20	1407-20300 #	NASA-CR-4091 NASA-CR-4099	p 40	N87-26086 * # N87-29899 * #
NAS 1	1.15:89848	. p 165		NASA-CASE-KSC-11368-1	p 102	N87-25583 * #	14.071 071 4000	P 40	1407-29099 #
NAS 1	1.15:89852	. р 44	N87-20353 * #		, p	20000 #	NASA-SP-7046(17)	p 39	N87-29576 *
	1.15:89854		N87-22237 * #	NASA-CASE-LAR-13113-1	p 36	N87-25492 *	NASA-SP-7056(04)		N87-26073 *
	l.15:89860 l.15:89863		N87-20477 * #	NASA-CASE-LAR-13393-1		N87-29118 *		•	
	1.15:89864		N87-23674 * # N87-22003 * #	NASA-CASE-LAR-13455-1		N87-21206 *	NASA-TM-100102	p 79	N87-24838 * #
NAS 1	1.15:89886	n 78	N87-22174 * #	NASA-CASE-LAR-13489-1		N87-27713 *	NASA-TM-100108	p 97	N87-25422 * #
NAS 1	.15:89889	. p 96	N87-22001 * #	NASA-CASE-LAR-13680-1	p 165	N87-25561 * #	NASA-TM-100110		N87-26135 * #
NAS 1	.15:89908	p 78	N87-23028 * #	NASA-CASE-LEW-14072-3	n 107	NR7 20706 *	NASA-TM-100113		N87-23821 * #
NAS 1	.15:89921	. p 96	N87-22949 * #		p 10/	1107-23/30	NASA-TM-100122 NASA-TM-100140		
	.15:89925		N87-22004 * #	NASA-CASE-MFS-28185-1	p 107	N87-25586 * #	NASA-TM-100140		N87-26144 * # N87-24520 * #
NAS 1	.15:89926	р 68	N87-23690 * #		•		NASA-TM-100308		N87-24520 # N87-24521 * #
NAS 1	.21:7046(17)	. p 39	N87-29576 *	NASA-CASE-MSC-20910-1	p 161	N87-25582 *	NASA-TM-100488		
NAS 1	.21:7056(04)	. p 4	N87-26073 *	NASA-CASE-MSC-21207-1	p 36	N87-25576 * #	NASA-TM-58279	p 53	N87-27392 * #
NAS 1	.26:171981	. p 136	N87-20335 * # N87-20351 * #				NASA-TM-86588		N87-21993 * #
NAS 1	.26:172002	n 81	N87-28188 * #	NASA-CASE-NPO-16640-1-CU	p 8	N87-21661 *	NASA-TM-86594		N87-24723 * #
NAS 1	.26:172003	p 53	N87-29117 * #	NASA CD 0447 DT 0	- 04		NASA-TM-86856	p 52	N87-24064 * #
NAS 1	.26:175093	p 54	N87-29594 * #	NASA-CP-2447-PT-2 NASA-CP-2460	p 34	N87-24495 * #	NASA-TM-87820		
NAS 1	.26:177447	p 130	N87-25767 * #	NASA-CP-2465	p 04	N87-20665 * # N87-21141 * #	NASA-TM-87826 NASA-TM-88957		
NAS 1	.26:178147	p 30	N87-21987 * #	NASA-CP-2467-PT-1	n 65	N87-22702 * #	NASA-TM-89051	p 96	N87-24536 * # N87-23687 * #
	.26:178192		N87-21995 * #	NASA-CP-2467-PT-2	p 66	N87-22729 * #	NASA-TM-89068	n 37	N87-26085 * #
NAS 1.	.26:178208	p 120	N87-20340 * #	NASA-CP-2470	p 103		NASA-TM-89072	D 26	N87-20352 * #
NAS I	.26:178276	p 8	N87-21020 * #	NASA-CP-2484	p 5	N87-29914 * #	NASA-TM-89111	p 140	N87-20795 * #
NAS 1	.26:178289	p 35	N87-25349 * # N87-24709 * #				NASA-TM-89118	p 86	N87-20339 * #
NAS 1.	.26:178310	n 120	N87-24162 * #	NASA-CR-171978		N87-20335 * #	NASA-TM-89137	p 45	N87-21021 * #
NAS 1.	.26:179055	p 161	N87-21018 * #	NASA-CR-171981		N87-20351 * #	NASA-TM-89221	p 137	N87-25339 * #
	.26:179085		N87-22758 * #	NASA-CR-172002 NASA-CR-172003		N87-28188 * #	NASA-TM-89285	p 116	N87-29124 * #
NAS 1.	.26:179138	p 97	N87-26081 * #	NASA-CR-175093	p 54	N87-29117 * # N87-29594 * #	NASA-TM-89286 NASA-TM-89295	p 116	
NAS 1.	26:179139	p 97	N87-26062 * #	NASA-CR-177447		N87-25767 * #	NASA-TM-89355	p /9	N87-25838 * # N87-27407 * #
NAS 1.	26:179140	р3	N87-26063 * #	NASA-CR-178147		N87-21987 * #	NASA-TM-89429-VOL-1		N87-22571 * #
NAS 1.	26:179141	p 4	N87-26066 * #	NASA-CR-178192	p 9	N87-21995 * #	NASA-TM-89429-VOL-2		N87-22570 * #
NAS 1.	26:179142 26:179143	p 4	N87-26067 * #	NASA-CR-178208	p 120	N87-20340 * #	NASA-TM-89436	p 128	N87-20841 * #
NAS 1	26:179144	p 3	N87-26065 * # N87-26064 * #	NASA-CR-178276	р8	N87-21020 * #	NASA-TM-89459	p 171	N87-25760 * #
NAS 1.	26:179147	p 71	N87-25801 * #	NASA-CR-178287		N87-25349 * #	NASA-TM-89847	p 93	N87-20378 * #
	26:179149		N87-26083 * #	NASA-CR-178289		N87-24709 * #	NASA-TM-89848	p 165	N87-20342 * #
NAS 1.	26:179165	p 39	N87-28581 * #	NASA-CR-178310 NASA-CR-179055		N87-24162 * # N87-21018 * #	NASA-TM-89852 NASA-TM-89854	p 44	N87-20353 * #
NAS 1.	26:179166	p 39	N87-28582 * #	NASA-CR-179085	p 101	N87-21018 # N87-22758 * #	NASA-TM-89860	p 96	N87-22237 * #
	26:179167		N87-28583 * #	NASA-CR-179138	97 0	N87-26081 * #	NASA-TM-89863		N87-20477 * # N87-23674 * #
NAS 1.	26:179185	p 131	N87-29585 * #	NASA-CR-179139	p 97	N87-26062 * #	NASA-TM-89864	p 96	N87-22003 * #
NAS 1	26:179587-VOL-1 26:179587-VOL-2	p /8	N87-23695 * #	NASA-CR-179140	р3	N87-26063 * #	NASA-TM-89886	p 78	N87-22174 * #
NAS 1.	26:180276	p 10	N87-23696 * # N87-27412 * #	NASA-CR-179141	p 4	N87-26066 * #	NASA-TM-89889		N87-22001 * #
	26:180301		N87-26927 * #	NASA-CR-179142	p 4	N87-26067 * #	NASA-TM-89908		N87-23028 * #
NAS 1.	26:180303	p 38	N87-26583 * #	NASA-CR-179144	n 3	N87-26065 * # N87-26064 * #	NASA-TM-89921 NASA-TM-89925		N87-22949 * #
	26:180312		N87-26936 * #	NASA-CR-179147		N87-25801 * #	NASA-TM-89926		N87-22004 * # N87-23690 * #
	26:180317		N87-27260 * #	NASA-CR-179149	p 130	N87-26083 * #		_ 50	
NAC 1	26:180342	p 53	N87-27405 * #	NASA-CR-179165	p 39	N87-28581 * #	NASA-TP-2661	p 28	N87-20567 * #
NAS 1	26:180391 26:180449	p /0	N87-24513 * #	NASA-CR-179166	p 39	N87-28582 * #	NASA-TP-2690	p 63	N87-20380 * #
NAS 12	26:180564	n 36 n ii u	N87-30107 * # N87-26071 * #	NASA-CR-179167	p 4	N87-28583 * #	NASA-TP-2710		N87-20568 * #
NAS 1.2	26:180579		N87-22508 * #	NASA-CR-179185	p 131	N87-29585 * #	NE 54 007		
	26:180633		N87-26365 * #	NASA-CR-179587-VOL-1 NASA-CR-179587-VOL-2	p /8	N87-23695 * #	NE-51-867	115 م	N87-26057 #
NAS 1.2	26:180698	p 28	N87-20569 * #	NASA-CR-180276	2 10	N87-23696 * # N87-27412 * #	NOAA-NESDIS-30	- 100	NO7 05500 #
NAS 1.2	26:180829	p 81	N87-28825 * #	NASA-CR-180301		N87-26927 * #		, 130	N87-25560 #
NAS 1.2	26:180920		N87-21996 * #	NASA-CR-180303	38	N87-26583 * #	OTA-BP-ISC-41	o 171	N87-21754 #
NAS 1.2	26:180922		N87-22509 * #	NASA-CR-180312	45	N87-26936 * #			n
NAS 1.2	26:180923 26:181004		N87-22242 * #	NASA-CR-180317	38	N87-27260 * #	PB87-118220	o 171	N87-21754 #
NAS 12	26:181009		N87-23066 * # N87-26072 * #	NASA-CR-180342		N87-27405 * #	·		
	26:181065		N87-23980 * #	NASA-CR-180391		N87-24513 * #	REPORT-85SDS2184-VOL-1B-PT-1	<b>)</b> 4	N87-26066 * #
NAS 1.2	26:181073	p 115	N87-24817 * #	NASA-CR-180449p	11	N87-30107 * #	DEDT-850D00404 VOL 44 DT		NOT 00000 : ::
NAS 1.2	26:181095	p 37	N87-26370 * #	NASA-CR-180564	120	N87-26071 * #	REPT-85SDS2184-VOL-1A-PT-1 . [		N87-26062 * #
NAS 1.2	26:181128j	p 137	N87-25443 * #	NASA-CR-180633		N87-22508 * # N87-26365 * #	REPT-85SDS2184-VOL-1A-PT-2 REPT-85SDS2184-VOL-1B-PT-2 R		N87-26063 * #
	26:181130	p 72	N87-26038 * #	NASA-CR-180698	28	N87-20569 * #	REPT-85SDS2184-VOL-2		N87-26067 * # N87-26065 * #
NAS 1.2	26:181156		N87-25605 * #	NASA-CR-180829	81	N87-28825 * #	REPT-85SDS2184-VOL-3		N87-26064 * #
	6:181163		N87-26173 * #	NASA-CR-180920p	157	N87-21996 * #	REPT-87B0275	129	N87-22457 * #
NAS 1.2	6:181165 6:181202		N87-26082 * #	NASA-CR-180922p	129	N87-22509 * #	REPT-87B0343	115	N87-27443 * #
	6:181221		N87-26397 * # N87-27702 * #	NASA-CR-180923p	102	N87-22242 * #	•		,,
	6:181253		N87-27702 * # N87-27704 * #	NASA-CR-181004 p		N87-23066 * #	S-REPT-100-87 p	171	N87-24240 #
	6:181287		N87-27704 # N87-27712 * #	NASA-CR-181009p		N87-26072 * #	0.550		
			101-21114 #	NASA-CR-181065p	34	N87-23980 * #	S-559 p	53	N87-27392 * #

3-300			
	- 100	NO7 20050 * #	SAR-2 p 129 N87-22509 * #
S-560	p 103	NO7-29030 #	OAKTE
			SAWE PAPER 1692 p 20 A87-36279
SAE P-177	p 162	A87-38701	SAME TALET TOOL IIIIIIIIIII P
			SCC-86-02 p 140 N87-21991 #
SAE PAPER 860916	p 47	A87-38708 *	,
SAE PAPER 860918		A87-38710 *	SD-TR-86-92 p 140 N87-21024 #
SAE PAPER 860920		A87-38712	SD-TR-87-34 p 110 N87-29709 #
SAE PAPER 860921		A87-38713	
SAE PAPER 860923	n 163	A87-38714 *	SEI-TR-86-13 p 29 N87-21388 #
SAE PAPER 860924	p 139	A87-38715 *	SEI-TR-86-14 p 35 N87-24517 #
SAE PAPER 860926	n 47	A87-38716	
SAE PAPER 860927	p 163	A87-38717	SES/DNP/TR/002/85 p 115 N87-28585 #
SAE PAPER 860928	p 163	A87-38718	SES/ENG/ES-519/86 p. 138 N87-28588 #
SAE PAPER 860930	p 48	A87-38720 *	SES/ENG/ES-519/86 p 138 N87-28588 #
SAE PAPER 860931	p 163	A87-38721 °	SPIE-644 p 125 A87-44176 *
SAE PAPER 860932	p 119	A87-38722 *	SPIE-644 p 125 A07-74770
SAE PAPER 860933	p 167	A87-38723	SR-5 p 131 N87-26967 #
SAE PAPER 860934	. р 163	A87-38724 *	5n-5
SAE PAPER 860936	. p 42	A87-38725	SSL-22-86 p 37 N87-26365 * #
SAE PAPER 860938	p 150	A87-38727	OOE-EL 00
SAE PAPER 860939	. p 150	A87-38728 A87-38729 *	SSS-R-87-8495 p 131 N87-26967 #
SAE PAPER 860942	. p 46	A87-38730 *	
SAE PAPER 860943	. p 40	A87-38731 *	SVIC-BULL-56-PT-1 p 29 N87-20574 #
SAE PAPER 860944	. р.46 р.48	A87-38732	
SAE PAPER 860945SAE PAPER 860946	. p 48	A87-38733 *	TR-0086(6935-05)-2 p 110 N87-29709 #
SAE PAPER 860947	. p 42	A87-38734 *	TR-0086(6940-05)-13 p 140 N87-21024 #
SAE PAPER 860948	. p 49	A87-38735	107.00070 #
SAE PAPER 860949	p 49	A87-38736	TRW-43543-6011-UE-00 p 140 N87-23678 #
SAE PAPER 860950	. р 49	A87-38737	HCRI-96258 p 171 N87-22697 #
SAE PAPER 860951	. р 49	A87-38738	UCRL-96258 p 171 N87-22697 #
SAE PAPER 860952	. р 164	A87-38739	US-PATENT-APPL-SN-032818 p 36 N87-25576 * #
SAE PAPER 860953	. p 164	A87-38740 *	US-PATENT-APPL-SN-052940 p 102 N87-25583 * #
SAE PAPER 860956	. p 164	A87-38741	US-PATENT-APPL-SN-052941 p 165 N87-25561 * #
SAE PAPER 860958	p 119	A87-38742 *	US-PATENT-APPL-SN-056930 p 107 N87-25586 * #
SAE PAPER 860959	p 42	A87-38743 A87-38747	US-PATENT-APPL-SN-640636 p 93 N87-20375
SAE PAPER 860965SAE PAPER 860966	n 150		US-PATENT-APPL-SN-760799 p 103 N87-29118 *
SAE PAPER 860967	р 190	A87-38749	US-PATENT-APPL-SN-783888 p 161 N87-25582 *
SAE PAPER 860968		A87-38750	US-PATENT-APPL-SN-804040 p 29 N87-21206 * US-PATENT-APPL-SN-831371 p 36 N87-25492 *
SAE PAPER 860969	p 164	A87-38751 *	US-PATENT-APPL-SN-831371 p 36 N87-25492 * US-PATENT-APPL-SN-834977 p 107 N87-23736 *
SAE PAPER 860970	р 50	A87-38752	US-PATENT-APPL-SN-852468 p 8 N87-21661 *
SAF PAPER 860971	p 50	A87-38753	US-PATENT-APPL-SN-890445 p 38 N87-27713 *
SAE PAPER 860972	p 120	A87-38754 *	
SAE PAPER 860973	p 134	A87-38755 * A87-38756 *	US-PATENT-CLASS-182-152 p 36 N87-25492 *
SAE PAPER 860974SAE PAPER 860975	p 124		US-PATENT-CLASS-182-223 p 103 N87-29118
SAE PAPER 860979	p 42	A87-38760	US-PATENT-CLASS-182-63 p 103 N87-29118 *
SAE PAPER 860982	p 50	A87-38761 *	US-PATENT-CLASS-182-82 p 103 N87-29118 *
SAE PAPER 860983	p 50	A87-38762 *	US-PATENT-CLASS-244-161 p 161 N87-25582 * US-PATENT-CLASS-250-251 p 8 N87-21661 *
SAF PAPER 860984	p 50	A87-38763 *	US-PATENT-CLASS-250-251 p 8 N87-21661 * US-PATENT-CLASS-250-341 p 29 N87-21206 *
SAE PAPER 860985	p 50	A87-38764 *	US-PATENT-CLASS-250-396-R p 8 N87-21661 *
SAE PAPER 860986	р 51	A87-38765	US-PATENT-CLASS-250-423-P p 8 N87-21661 *
SAE PAPER 860987	p 51	A87-38766 * A87-38767	US-PATENT-CLASS-285-27 p 38 N87-27713 *
SAE PAPER 860990	p 13-	A87-38768	US-PATENT-CLASS-285-31 p 38 N87-27713 *
SAE PAPER 860991SAE PAPER 860992	n 134	A87-38769 *	US-PATENT-CLASS-285-373 p 38 N87-27713 *
SAE PAPER 860993	p 51	A87-38770 *	US-PATENT-CLASS-285-421 p 38 N87-27713 *
SAE PAPER 860994	p 51	A87-38771 *	US-PATENT-CLASS-285-86 p 38 N87-27713 *
SAE PAPER 860995	p 51	A87-38772 *	US-PATENT-CLASS-292-DIG.49 p 161 N87-25582 *
SAE PAPER 860996	p 51	A87-38773 *	US-PATENT-CLASS-292-201 p 161 N87-25582 * US-PATENT-CLASS-292-64 p 161 N87-25582 *
SAE PAPER 860997	p 51	A87-38774	US-PATENT-CLASS-292-64 p 161 N87-25582 * US-PATENT-CLASS-374-122 p 29 N87-21206 *
SAE PAPER 860998	р 42	A87-38775 *	US-PATENT-CLASS-374-122 p 29 N87-21206 *
SAE PAPER 860999	p 43	A87-38776	US-PATENT-CLASS-376-127 p 8 N87-21661 *
SAE PAPER 861005	р в9	A87-38778 * A87-38779	US-PATENT-CLASS-403-341 p 38 N87-27713 *
SAE PAPER 861007SAE PAPER 861008	n 12		US-PATENT-CLASS-428-421 p 107 N87-23736 *
SAE PAPER 861009	p 13.	4 A87-38781	US-PATENT-CLASS-428-422 p 107 N87-23736 *
SAE PAPER 861010	p 13	5 A87-38782	US-PATENT-CLASS-428-447 p 107 N87-23736 *
SAE PAPER 861013	р 16	0 A87-38783	US-PATENT-CLASS-428-473.5 p 107 N87-23736 *
SAE PAPER 861014	p 11	9 A87-38784 *	US-PATENT-CLASS-428-702 p 107 N87-23736 * US-PATENT-CLASS-52-108 p 36 N87-25492 *
SAE PAPER 861621	р74	A87-32578	US-PATENT-CLASS-52-108 p 36 N87-25492 * US-PATENT-CLASS-52-632 p 36 N87-25492 *
SAF PAPER 861622	р74	A87-32579	US-PATENT-CLASS-52-646 p 36 N87-25492 *
SAF PAPER 861681	p 16	0 A87-32598 <sup>-</sup>	DOTATESTOCKO P 44
SAE PAPER 861723	p 13	2 A87-32612	US-PATENT-4,609,169 p 93 N87-20375
SAE PAPER 861724	p 13	A87-32625	US-PATENT-4,645,358 p 29 N87-21206 *
SAE PAPER 861764SAE PAPER 861783	p 1		US-PATENT-4,649,273 p 8 N87-21661 *
SAE PAPER 861784	p 99	A87-32633	US-PATENT-4,664,980 p 107 N87-23736 *
SAE PAPER 861785	p 13	3 A87-32634 *	US-PATENT-4,677,803 p 36 N87-25492 *
SAE DAPER 861790	p5	A87-32639	
SAE PAPER 861796	p 13	3 A87-32644	US-PATENT-4,684,156 p 38 N87-27713 * US-PATENT-4,685,535 p 103 N87-29118 *
SAE PAPER 861797	р88	A87-32645	US-FATENT-4,000,000 p 100 1407-20110
SAE PAPER 861818	p 14	7 A87-32655	USC-53-4507-0031 p 70 N87-24513 * #
SAE PAPER 861821		A87-32657 * A87-32658 *	,
SAE PAPER 861822	p 13		UVA/528224-MAE86-105 p 72 N87-27704 * #
SAE PAPER 861825SAE PAPER 861828	p 41	A87-32662	
SAE PAPER 861829	p 41	A87-32663 *	
SAE PAPER 861831	р 41		
SAE PAPER 861833	p 41	A87-32666	
SAE PAPER 861834			
		e No7 00005 * #	
SAIC-1-120-778-C14 SAIC-87/1514	p 13	86 N87-20335 * #	
SAIC-8//1514	р к	70 1401-20000 #	

**JULY 1988** 

#### **Typical Accession Number Index Listing**



Listings in this index are arranged alpha-numerically by accession number. The page number listed to the right indicates the page on which the citation is located. An asterisk (\*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

A87-25396 *	# p 166	A87-32444	p 55
A87-29133	р5	A87-32446	p 55
A87-31461 *	#p84	A87-32447	p 55
A87-31462 *	p 84	A87-32448	p 55
A87-31463	p 111		•
A87-31493	р 99	A87-32449	p 99
A87-31505	p 11	A87-32455	p 46
A87-31518	p 111	A87-32456	p 145
A87-31681 *	p 54	A87-32457	p 46
A87-32006	p 132	A87-32458	p 46
A87-32017 *	p 166	A87-32459	p 46
A87-32058 *	p 11	A87-32460	p 166
A87-32059	p 105	A87-32474	p 132
A87-32060	p 105	A87-32475	p 145
A87-32061 *	p 105	A87-32507	p 145
A87-32075	p 111	A87-32521	p 121
A87-32116	p 1	A87-32528	p 145
A87-32117	p 54	A87-32529	p 118
A87-32120	p <u>1</u> 1	A87-32530	p 145
A87-32121	p 5	A87-32531	p 145
A87-32175 *#		A87-32532	p 145
A87-32192 *#		A87-32533	p 122
	# p11	A87-32534	p 146
A87-32235 * #		A87-32535	p 146
A87-32236 * #		A87-32536 A87-32537	p 122
A87-32276	p 166	A87-32538	p 146
A87-32277 * A87-32278	p 1	A87-32539	p 122 p 146
A87-32278 A87-32280	p 143	A87-32539 A87-32540	p 146 p 146
A87-32281	p 143	A87-32541	p 146
A87-32282	p 143	A87-32542	p 146
A87-32285	p 143 p 143	A87-32543	p 132
A87-32286	p 143	A87-32544	p 46
A87-32288	p 100	A87-32545	p 12
A87-32306	p 74	A87-32546	p 147
A87-32334	D 144	A87-32547	p 147
A87-32335	p 144	A87-32548	p 12
A87-32336 *	p 11	A87-32549	p 160
A87-32337 *	p 12	A87-32578	p 74
A87-32338	p 54	A87-32579	p 74
A87-32339	p 144	A87-32598 *	p 160
A87-32340	p 12	A87-32612	p 132
A87-32341	D 144	A87-32613	p 118
A87-32342	p 105	A87-32625	p 1
A87-32346	p 144	A87-32632	p 47
A87-32368	p 144	A87-32633	p 99
A87-32369	p 40	A87-32634 *	p 133
A87-32370	p 144	A87-32639	p 5
A87-32377	p 41	A87-32644	p 133
A87-32388	p 145	A87-32645	p 88
A87-32405	p 12	A87-32655	p 147
A87-32440	p 54	A87-32657 *	р6
A87-32441		A87-32658 *	p 13
	p 54	A87-32662	p 41
A87-32442	p 12	A87-32663 *	n 41

A87-32443

p 12

A87-32665

A87-32666 *	p 41
A87-32667 *	p 133
A87-32668 *	p 41
A87-32726	p 55
A87-32727 *	p 55
A87-32729	p 13
A87-32730	p 55
A87-32732 *	
	p 56
, 10. OE. 00	p 133
A87-32736 *	p 56
A87-32741	p 56
A87-32743 *	p 133
A87-32744 *	
	p 133
	p 99
A87-32746 *	p 99
A87-32747 °	p 75
A87-32801	p 147
A87-32802	p 1
A87-32802 A87-32814	
A07-32014	p 147
A87-32815	p 148
A87-32819	p 148
A87-33001	p 162
A87-33002	p 162
A87-33003 *	p 118
A87-33013	p 47
A87-33019 *	p 167
A87-33021	p 162
A87-33022	
	p 162
A87-33040	p 111
A87-33048	p 118
A87-33050	p 6
A87-33100 * #	p 105
A87-33475	
A87-33551	
	p 13
A87-33557 #	р6
A87-33560 *#	р6
A87-33561 * #	p 6
A87-33564 #	
A87-33565 *#	p 13
A87-33573 *#	p 56
A87-33588 #	p 13
A87-33591 #	p 14
A87-33610 * #	
	p 14
A87-33611 *#	p 14
A87-33613 *#	p 14
A87-33632 #	p 14
A87-33633 * #	p 15
A87-33634 *#	p 15
A07 20005 #	•
A87-33635 #	p 15
A87-33636 * #	p 15
A87-33639 #	p 105
A87-33654	p 15
A87-33658 * #	p 15
A87-33665 *#	p 6
A87-33667 #	
	p 148
A87-33669 #	p 16
A87-33670 * #	p 16
A87-33679 #	p 16
A87-33687 #	p 122
	p 16
	p 16
A87-33708 * #	p 16
A87-33709 * #	p 17
A87-33710 #	p 56
A87-33711 * #	p 17
A87-33712 *#	
A07-00712 #	
A87-33713 * #	p 56
A87-33714 * #	p 57
A87-33727 #	p 17
A87-33728 * #	p 7
A87-33730 #	p 57
A87-33730 # A87-33731 *#	
	p 57
A87-33737 #	p 17
A87-33738 #	p 57
A87-33739 * #	p 17
A87-33741 #	
A87-33742 #	p 18
A87-33745 #	p 18
A87-33751 #	p 18
A87-33752 * #	
	•
A87-33754 #	p 19
A87-33755 *#	p 19
A87-33757 #	D 19

p 19

A87-33787 * p 75	A87-38710 *	p 118
A87-33867 * # p 100	A87-38712	p 47
A87-34047 p 148	A87-38713	p 163
A87-34207 p 148	A87-38714 *	p 163
A87-34208 p 148	A87-38715 * A87-38716	p 139
A87-34345 p 148	A87-38717	p 47 p 163
A87-34460 *# p 138	A87-38718	p 163
A87-34467 # p 19 A87-34469 * # p 42	A87-38720 *	p 48
A87-34510 # p 19	A87-38721 *	p 163
A87-34594 p 149	A87-38722 *	p 119
A87-34595 p 149	A87-38723 A87-38724 *	p 167
A87-34597 p 167	A87-38725	p 163 p 42
A87-34701 # p 19 A87-34712 * p 88	A87-38727	p 150
A87-34712 * p 88 A87-34797 p 84	A87-38728	p 150
A87-34870 p 167	A87-38729 *	p 48
A87-34871 p 122	A87-38730 * A87-38731 *	p 48 p 48
A87-34874 p 149	A87-38732	p 46 p 48
A87-35076 # p 149	A87-38733 *	p 48
A87-35077 # p 149 A87-35222 * p 122	A87-38734 *	p 42
A87-35282 p 111	A87-38735	p 49
A87-35327 p 19	A87-38736	p 49
A87-35599 p 162	A87-38737 A87-38738	p 49
A87-35600 p 47	A87-38739	р 49 р 164
A87-35718 ° p 7 A87-35799 p 75	A87-38740 *	p 164
A87-35799 p 75 A87-35877 p 149	A87-38741	p 164
A87-36279 p 20	A87-38742 *	p 119
A87-36362 p 134	A87-38743 A87-38747	p 42
A87-36531 * p 123	A87-38748	p 150 p 150
A87-36756 p 88 A87-36762 p 57	A87-38749	p 49
A87-36762 p 57 A87-36913 * # p 75	A87-38750	p 49
A87-36944 p 75	A87-38751 *	p 164
A87-37135 p 7	A87-38752 * A87-38753	p 50
A87-37291 *# p 75	A87-38754 *	р 50 р 120
A87-37293 # p 111	A87-38755 *	p 120
A87-37294 * # p 112 A87-37295 * p 58	A87-38756 *	p 124
A87-37297 * # p 134	A87-38757 *	p 124
A87-37298 * p 7	A87-38760	p 42
A87-37300 * # p 100	A87-38761 * A87-38762 *	p 50 p 50
A87-37431 p 112	A87-38763 *	p 50
A87-37785 p 123 A87-37853 p 149	A87-38764 *	p 50
A87-37962 p 150	A87-38765	p 51
A87-37963 p 1	A87-38766 *	p 51
A87-37964 p 150	A87-38767 A87-38768	р 134 р 164
A87-37968 * p 112 A87-37971 p 150	A87-38769 *	p 134
A87-37971 p 150 A87-38001 # p 88	A87-38770 *	p 51
A87-38002 # p 123	A87-38771 *	p 51
A87-38003 # p 88	A87-38772 * A87-38773 *	р 51 р 51
A87-38004 * # p 89	A87-38774	p 51
A87-38015 # p 89 A87-38016 # p 89	A87-38775 *	p 42
A87-38443 p 150	A87-38776	p 43
A87-38567 * p 123	A87-38778 *	p 89
A87-38568 * p 123	A87-38779 A87-38780	р 52 р 134
A87-38569 ° p 89 A87-38570 p 123	A87-38781	p 134
A87-38570 p 123 A87-38571 * p 123	A87-38782	p 135
A87-38572 ° p 89	A87-38783	p 160
A87-38573 p 124	A87-38784 *	p 119
A87-38574 ° p 124	A87-38785 A87-38824 #	p 89 p 21
A87-38576 p 167 A87-38579 p 167	A87-39183	p 124
A87-38579 p 167 A87-38600 p 20	A87-39426 #	p 106
A87-38601 * p 20	A87-39543 * #	p 21
A87-38609 * p 20	A87-39594 #	p 151
A87-38610 ° p 20	A87-39628 # A87-39629 #	р 76 р 76
A87-38612 p 20	A87-39644 #	p 58
A87-38622 p 139 A87-38623 * p 139	A87-39735	p 76
A87-38623 * p 139 A87-38624 p 139	A87-39836	p 151
A87-38625 * p 106	A87-39958 *	p 58
A87-38641 p 106	A87-40051	p 1
A87-38642 p 106	A87-40068 * #	p 167
A87-38643 * p 139 A87-38701 p 162	A87-40074 # A87-40075 #	p 58 p 21
A87-38701 p 162	70/- <del>4</del> 00/3 #	U 2 I

A87-38708 \*

p 162 p 47

p 21

p 164

A87-40098

#### A87-40286

A87-40286			ACCESOIG	on the second se
A87-40286 p 168	A87-45191 * p 91	A87-50442 # p 23	N87-20372 # p 28	N87-22256 # p 30
A87-40319 * # p 124	A87-45192 # p 135	A87-50443 # p 23	N87-20373 # p8 N87-20374 # p28	N87-22269 # p 30 N87-22457 * # p 129
A87-40339 p 151	A87-45196 # p 91	A87-50444 # p 23	N87-20375 p 93	N87-22508 * # p 129
A87-40342 p 151	A87-45255 * # p 91 A87-45256 * # p 91	A87-50445 # p 24	N87-20378 * # p 93	N87-22509 * # p 129
A87-40351 p 2	A87-45257 # p 152	A87-50446 # p 24 A87-50447 # p 126	N87-20380 * # p 63 N87-20477 * # p 63	N87-22551 # p 137
A87-40353 * # p 120	A87-45258 # p 44	A87-50471 *# p 24	N87-20477 * # p 63 N87-20564 p 28	N87-22560 # p 171
A87-40358 p 112 A87-40359 p 112	A87-45259 * # p 91 A87-45260 # p 91	A87-50472 # p 61	N87-20567 * # p 28	N87-22570 * # p 129 N87-22571 * # p 129
A87-40363 p 119	A87-45260 # p 91 A87-45287 # p 91	A87-50473 # p 24	N87-20568 * # p 28	N87-22697 # p 171
A87-40376 p 135	A87-45311 # p 92	A87-50474 * # p 61 A87-50475 # p 61	N87-20569 * # p 28 N87-20574 # p 29	N87-22702 * # p 65
A87-40377 p 135	A87-45357 # p 92	A87-50486 # p 61	N87-20574 # p 29 N87-20577 # p 63	N87-22703 * # p 30
A87-40378 * # p 76 A87-40380 p 85	A87-45360 # p 92 A87-45363 # p 77	A87-50502 # p 24	N87-20581 * # p 8	N87-22704 * # p 30 N87-22705 * # p 31
A87-40381 p 112	A87-45365 # p77 A87-45439 # p92	A87-50503 # p 61	N87-20584 * # p 77	N87-22706 * # p 65
A87-40510 # p 124	A87-45441 # p 160	A87-50504 # p 24 A87-50505 * # p 61	N87-20599 # p 29 N87-20621 # p 128	N87-22707 * # p 31
A87-40513 # p 151 A87-40844 # p 100	A87-45476 p 169	A87-50506 # p 25	N87-20622 # p 128	N87-22708 * # p 65 N87-22710 * # p 31
A87-40844 # p 100 A87-40858 # p 124	A87-45483 * p 85 A87-45485 * p 113	A87-50507 # p 25	N87-20623 # p 156	N87-22710 * # p 31 N87-22711 * # p 9
A87-40859 * # p 125	A87-45519 * p 85	A87-50509 * # p 93 A87-50511 # p 77	N87-20624 # p 156 N87-20625 # p 128	N87-22712 * # p 31
A87-40866 # p 21	A87-45520 p 85	A87-50531 *# p 62	N87-20625 # p 128 N87-20626 # p 156	N87-22713 * # p 31
A87-40867 # p 58 A87-40869 # p 58	A87-45521 p 113 A87-45522 p 85	A87-50533 # p 161	N87-20627 # p 156	N87-22714 * # p 65 N87-22715 * # p 65
A87-41022 p 106	A87-45522 p 85 A87-45523 p 2	A87-50558 * # p 62 A87-50561 * # p 62	N87-20628 # p 136	N87-22716 *# p 9
A87-41052 p 21	A87-45524 * p 86	A87-50561 * # p 62 A87-50562 * # p 62	N87-20629 # p 156 N87-20630 # p 114	N87-22717 * # p 66
A87-41103 * # p 58 A87-41122 # p 90	A87-45525 p 136	A87-50750 * # p 127	N87-20631 # p 128	N87-22718 * # p 31 N87-22719 * # p 31
A87-41145 *# p 76	A87-45797 * p 100 A87-46000 * # p 136	A87-50792 p 154	N87-20632 # p 170	N87-22719 # p 66
A87-41152 # p 100	A87-46121 p 152	A87-51610 p 62 A87-51713 * p 140	N87-20633 # p 161 N87-20634 # p 128	N87-22721 * # p 9
A87-41153 # p 100	A87-46281 p 86	A87-51772 p 107	N87-20634 # p 128 N87-20635 # p 156	N87-22722 *# p 78
A87-41159 * # p 21 A87-41161 * # p 135	A87-46301 * p 59 A87-46332 * p 169	A87-51793 p 25	N87-20636 # p 157	N87-22723 * # p 66 N87-22724 * # p 32
A87-41218 p 168	A87-46332 * p 169 A87-46682 p 44	A87-51794 p 107 A87-51869 p 169	N87-20637 # p 161	N87-22725 * # p 32
A87-41219 p 151	A87-46704 # p 100	A87-51869 p 169 A87-51870 p 155	N87-20638 # p 157 N87-20639 # p 114	N87-22726 * # p 32
A87-41222 p 168	A87-46793 * # p 22	A87-51979 # p 101	N87-20639 # p 114 N87-20640 # p 157	N87-22727 * # p 32
A87-41302 # p 85 A87-41429 p 151	A87-46872 # p 153 A87-46875 p 169	A87-52247 * # p 93	N87-20641 # p 136	N87-22728 * # p 32 N87-22729 * # p 66
A87-41430 p 125	A87-46945 p 153	A87-52252 *# p 62 A87-52450 * p 127	N87-20665 * # p 64	N87-22730 *# p 66
A87-41568 p 168	A87-46975 p 169	A87-52965 * # p 63	N87-20667 * # p 170 N87-20668 * # p 64	N87-22731 * # p 66
A87-41570 p 151 A87-41571 * p 168	A87-47302 p 153	A87-52966 # p 25	N87-20669 *# p 64	N87-22732 * # p 66 N87-22733 * # p 32
A87-41572 p 168	A87-47327 p 22 A87-47726 p 169	A87-52968 # p 63 A87-52973 # p 63	N87-20682 * # p 3	N87-22734 * # p 67
A87-41573 p 135	A87-47809 * # p 22	A87-52973 # p 63 A87-53002 * p 127	N87-20732 # p 157 N87-20735 # p 157	N87-22735 * # p 9
A87-41574 p 21 A87-41575 * p 90	A87-47810 # p 59	A87-53059 # p 101	N87-20774 # p 101	N87-22736 * # p 67 N87-22737 * # p 67
A87-41575 * p 90 A87-41609 *# p 85	A87-47811 # p 59 A87-47812 * # p 22	A87-53082 * p 2	N87-20795 * # p 140	N87-22738 * # p 33
A87-41611 * # p 7	A87-47868 p 169	A87-53083 p 170 A87-53085 p 170	N87-20841 *# p 128	N87-22739 * # p 33
A87-41613 * # p 22	A87-48156 p 101	A87-53086 p 2	N87-21018 * # p 161 N87-21020 * # p 8	N87-22740 *# p 78
A87-41615 * # p 90 A87-41617 p 59	A87-48157 p 153 A87-48264 p 77	A87-53089 p 165	N87-21021 *# p 45	N87-22741 * # p 9 N87-22742 * # p 67
A87-41666 p 52	A87-48264 p 77 A87-48273 * p 60	A87-53117 p 155	N87-21024 # p 140	N87-22743 * # p 33
A87-41678 p 152	A87-48341 p 23	A87-53149 p 127 A87-53554 # p 155	N87-21025 # p 29 N87-21030 # p 29	N87-22744 * # p 165
A87-41870 p 119 A87-41954 p 152	A87-48572 *# p 92	A87-53558 p 155	N87-21141 *# p 94	N87-22745 * # p 33 N87-22746 * # p 67
A87-42265 # p 77	A87-48578 # p 153 A87-48579 # p 153	A87-53559 p 155	N87-21142 * # p 94	N87-22747 * # p 33
A87-42266 # p 152	A87-48580 # p 153	A87-53560 p 155 A87-53916 # p 155	N87-21143 *# p 94	N87-22749 * # p 33
A87-42267 # p 168 A87-42505 # p 59	A87-48581 # p 153	A87-53923 # p 156	N87-21144 * # p 94 N87-21145 * # p 94	N87-22750 * # p 33
A87-42505 # p 59 A87-42585 * p 125	A87-48582 * # p 119 A87-48583 # p 113	A87-53924 # p 170	N87-21146 *# p 94	N87-22751 * # p 33 N87-22752 * # p 67
A87-42655 * p 59	A87-48585 # p 154	A87-53946 p 107 A87-53979 * p 52	N87-21147 *# p 94	N87-22753 * # p 67
A87-42678 * # p 22	A87-48587 * # p 113	A87-53979 p 32 A87-53989 p 170	N87-21148 * # p 95 N87-21149 * # p 95	N87-22756 # p 129
A87-42680 p 90 A87-42816 * p 59	A87-48588 * # p 113 A87-48589 * # p 113	A87-53991 p 101	N87-21150 * # p 95	N87-22758 * # p 67 N87-22761 # p 68
A87-42817 * p 59	A87-48589 * # p 113 A87-48590 # p 113	A87-54196 p 93 A87-54197 p 127	N87-21151 *# p 95	N87-22762 # p 120
A87-42821 * p 112	A87-48592 # p 154	A87-54197 p 127 A87-54198 p 127	N87-21152 * # p 95 N87-21153 * # p 77	N87-22876 # p86
A87-42923 p 152 A87-43003 # p 43	A87-48593 *# p 114		N87-21154 *# p8	N87-22949 * # p 96 N87-23028 * # p 78
A87-43004 # p 77	A87-48594 * # p 169 A87-48595 # p 154	N87-20306 *# p 136	N87-21155 * # p 52	N87-23066 *# p 140
A87-43014 # p 43	A87-48596 # p 154	N87-20307 * # p 25 N87-20311 * # p 170	N87-21158 * # p 95 N87-21206 * p 29	N87-23157 *# p 9
A87-43027 * # p 90 A87-43031 # p 160	A87-48597 *# p 119	N87-20325 * # p 165	N87-21335 p 64	N87-23161 *# p 114
A87-43031 # p 160 A87-43048 * # p 43	A87-48600 * # p 114 A87-48601 # p 2	N87-20335 * # p 136	N87-21388 # p 29	N87-23674 * # p 121 N87-23677 # p 161
A87-43059 * # p 43	A87-48602 # p 7	N87-20339 * # p 86 N87-20340 * # p 120	N87-21585 * # p 165	N87-23678 # p 140
A87-43060 *# p 135	A87-48605 # p 154	N87-20340 # p 120	N87-21661 * p8 N87-21753 # p170	N87-23680 # p3
A87-43103 * # p 43 A87-43122 # p 52	A87-48606 * # p 114	N87-20347 p 25	N87-21754 # p 171	N87-23681 # p 68 N87-23682 # p 137
A87-43125 *# p 44	A87-48607 * # p 114 A87-48714 # p 23	N87-20348 p 26	N87-21973 # p 128	N87-23682 # p 137 N87-23683 # p 34
A87-43126 * # p 44	A87-49026 * p 139	N87-20351 * # p 120 N87-20352 * # p 26	N87-21979 # p 157	N87-23687 * # p 68
A87-43154 * p 125 A87-43156 p 152	A87-49030 p 154	N87-20353 *# p 44	N87-21987 * # p 30 N87-21989 p 64	N87-23690 * # p 68
A87-43156 p 152 A87-43165 * p 125	A87-49615 * # p 92 A87-49617 # p 93	N87-20355 # p 26	N87-21991 # p 140	N87-23695 * # p 78 N87-23696 * # p 79
A87-43354 # p 125	A87-49618 * # p 136	N87-20356 * # p 2 N87-20357 # p 156	N87-21992 # p 30	N87-23736 * p 107
A87-44176 * p 125	A87-49797 * p 106	N87-20357 # p 156 N87-20358 # p 26	N87-21993 * # p 64 N87-21994 * # p 65	N87-23821 * # p 96
A87-44184 * p 126 A87-44185 * p 126	A87-49967 # p 154	N87-20359 # p 127	N87-21994 # p 03 N87-21995 * # p 9	N87-23980 * # p 34 N87-24028 # p 68
A87-44186 * p 126	A87-50033 p 60 A87-50157 # p 86	N87-20360 # p 86	N87-21996 * # p 157	N87-24028 # p 68 N87-24064 * # p 52
A87-44187 * p 126	A87-50197 *# p 93	N87-20361 * # p 26 N87-20362 # p 26	N87-22001 *# p 96	N87-24162 * # p 120
A87-44375 p 168	A87-50232 p 23	N87-20362 # p 26	N87-22003 * # p 96 N87-22004 * # p 78	N87-24240 # p 171
A87-44392 p 139 A87-44533 * p 126	A87-50401 p 60 A87-50404 # p 60	N87-20364 # p 27	N87-22060 p 65	N87-24258 * # p 129 N87-24486 # p 102
A87-44588 p 22	A87-50404 # p 60 A87-50412 * # p 7	N87-20365 # p 27	N87-22174 *# p 78	N87-24490 # p 68
A87-44683 p 152	A87-50413 # p 60	N87-20366 # p 27 N87-20367 # p 27	N87-22231 # p 101	N87-24491 # p 69
A87-44741 p 106 A87-44830 *# p 44	A87-50414 # p 60	N87-20368 # p 27	N87-22233 # p 102 N87-22237 * # p 96	N87-24495 * # p 34
A87-44832 # p 90	A87-50415 # p 60	N87-20369 # p 27	N87-22237 * # p 96 N87-22242 * # p 102	N87-24496 * # p 171 N87-24497 * # p 34
A87-44843 * # p 44	A87-50416 *# p 23	N87-20370 # p 101 N87-20371 # p 63	N87-22242 # p 102 N87-22252 # p 30	N87-24498 * # p 69
A87-45190 # p 90	A87-50417 # p86	N87-20371 # p 63		

N87-24499 *#	p 87	N87-26133 * #	p 98	NO7 20577	- 100
N87-24500 * #		N87-26135 * #	•	N87-28577 N87-28581 * #	р 138 р 39
N87-24501 * #		N87-26144 * #		N87-28582 * #	
N87-24502 * #	p 69		•	N87-28583 * #	p 4
N87-24503 *#	p 87	N87-26173 * #	•	N87-28584 #	p 110
N87-24504 * #		N87-26174 * #		N87-28585 #	p 115
N87-24505 * #		N87-26175 * # N87-26176 * #		N87-28586 #	p 115
N87-24506 * #		N87-26177 * #		N87-28588 #	p 138
N87-24507 * #		N87-26178 * #		N87-28825 * #	p 81
N87-24508 * #		N87-26179 * #		N87-28937	p 39
N87-24509 * # N87-24510 * #		N87-26180 * #		N87-28959 #	p 81
N87-24511 * #		N87-26181 * #		N87-28960 #	p 81
N87-24512 *#		N87-26182 * #		N87-28961 #	p 81
N87-24513 * #		N87-26183 * #	p 141	N87-28968 # N87-28972 #	p 159
N87-24514 #	p 70	N87-26185 * #	p 4	N87-28972 # N87-28973 #	р 81 р 82
N87-24515	p 140	N87-26186 * #	p 141	N87-28974 #	p 159
N87-24516 #	p 35	N87-26188 * #	p 131	N87-28975 #	p 82
N87-24517 #	p 35	N87-26189 * #	p 108	N87-28976 #	p 82
N87-24520 * #	p 35	N87-26190 * #	p 109	N87-28977 #	p 82
N87-24521 * #	p 70	N87-26191 * # N87-26192 * #	p 131 p 45	N87-28979 #	p 82
N87-24530 #	p 79	N87-26197 * #	p 109	N87-28980 #	p 82
N87-24532 #	p 79 - 70	N87-26198 * #	p 109	N87-28981 #	p 82
N87-24533 # N87-24536 * #		N87-26200 * #	p 109	N87-28982 #	p 82
N87-24641 * #	p 96 p 97	N87-26201 * #	p 109	N87-28984 #	p 83
N87-24709 * #	p 10	N87-26202 * #	p 109	N87-28985 # N87-28986 #	p 83
N87-24723 * #	p 70	N87-26203 * #	p 110	N87-28988 #	р 83 р 159
N87-24817 * #	p 115	N87-26204 * #	p 142	N87-28989 #	p 159
N87-24838 * #	p 79	N87-26205 * #	p 10	N87-29002 #	p 100
N87-25024 #	p 171	N87-26206 * #	p 110	N87-29004 #	p 83
N87-25031 #	p 157	N87-26207 * #	p 142	N87-29006 #	p 83
N87-25033 #	p 130	N87-26355 N87-26365 * #	p 102 p 37	N87-29009 #	p 103
N87-25336 #	p 102	N87-26370 * #	p 37	N87-29010 #	p 83
N87-25337 #	p 102	N87-26387	p 37	N87-29012 #	p 39
N87-25339 * # N87-25340 #	p 137	N87-26397 * #	p 37	N87-29015 #	p 159
N87-25340 #	p 158 p 35	N87-26414 * #	p 80	N87-29024 #	p 159
N87-25350 #	p 70	N87-26424 * #	p 80	N87-29117 * # N87-29118 *	p 53
N87-25351 #	p 130	N87-26429 * #	p 80	N87-29124 * #	p 103
N87-25352 #	p 71	N87-26447 * #	p 80	N87-29127 * #	p 116 p 116
N87-25354 #	p 171	N87-26449 * #	p 131	N87-29128 * #	p 116
N87-25355 * #	p 71	N87-26452 * #	p 80	N87-29129 * #	p 10
N87-25356 #	p 71	N87-26583 * #	p 38	N87-29144 * #	p 116
N87-25357 #	p 35	N87-26698 * # N87-26699 * #	p 115 p 80	N87-29145 * #	p 116
N87-25358 #	p 71	N87-26700 * #	p 72	N87-29146 * #	p 116
N87-25359 #	p 35	N87-26703 * #	p 53	N87-29148 * #	p 116
N87-25360 # N87-25395 #	p 71	N87-26841	p 121	N87-29149 * #	p 116
N87-25418 #	р 71 р 158	N87-26842	p 158	N87-29150 * #	p 116
N87-25422 * #	p 136 p 97	N87-26921	p 38	N87-29151 * #	p 117
N87-25430 #	p 107	N87-26927 * #	p 137	N87-29152 * # N87-29153 * #	p 117
N87-25443 * #	p 137	N87-26936 * #	p 45	N87-29155 * #	p 117 p 172
N87-25480 * #	p 107	N87-26937 #	p 142	N87-29157 * #	p 117
N87-25492 *	p 36	N87-26942 #	p 142	N87-29160 * #	p 117
N87-25506	p 130	N87-26946 * #	p 142	N87-29161 * #	p 88
N87-25560 #	p 130	N87-26949 # N87-26952 #	p 142 p 143	N87-29162 *#	p 73
N87-25561 * #	p 165	N87-26953 #	p 158	N87-29163 * #	p 4
N87-25576 * # N87-25582 *	p 36	N87-26954 #	p 143	N87-29164 * #	p 5
N87-25583 * #	p 161 p 102	N87-26957 #	p 143	N87-29165 * #	p 117
N87-25586 *#	p 107	N87-26959 #	р 87	N87-29166 * #	p 117
N87-25605 *#	p 36	N87-26960 #	p 87	N87-29167 * # N87-29168 * #	p 117
N87-25606 * #	p 36	N87-26961 #	p 87	N87-29217 #	р 138 р 46
N87-25760 * #	p 171	N87-26964 #	p 172	N87-29553 #	p 160
N87-25767 * #	p 130	N87-26966 # N87-26967 #	p 72	N87-29576 *	p 39
N87-25801 * #	p 71	N87-26968 #	p 131 p 103	N87-29583 #	p 5
N87-25805 #	p 72	N87-26970	p 72	N87-29585 * #	p 131
N87-25815 # N87-25838 * #	p 171 p 79	N87-27259 #	p 38	N87-29590 * #	p 39
N87-25888 * #	p 97	N87-27260 * #	p 38	N87-29591 * #	p 131
N87-25890 * #	p 115	N87-27392 * #	p 53	N87-29593 * #	p 103
N87-26038 * #	p 72	N87-27405 * #	p 53	N87-29594 * # N87-29633 * #	p 54
N87-26057 #	p 115	N87-27407 * #	p 53	N87-29709 #	p 132 p 110
N87-26058 #	p 97	N87-27408 #	p 103	N87-29713 * #	p 74
N87-26062 *#	p 97	N87-27412 * #	p 10	N87-29858 * #	p 103
N87-26063 * #	p 3	N87-27443 * #	p 115	N87-29859 * #	p 40
N87-26064 * #	p 3	N87-27687 #	p 158	N87-29860 * #	p 40
N87-26065 * #	p 3	N87-27688 # N87-27693 #	p 158 p 158	N87-29861 *#	p 161
N87-26066 * #	p 4	N87-27695 #	p 158	N87-29864 * #	p 40
N87-26067 * # N87-26071 * #	p 4 p 36	N87-27698 #	p 158	N87-29865 * #	p 104
N87-26071 * # N87-26072 * #	p 36 p 45	N87-27702 * #	p 45	N87-29866 * #	p 104
N87-26072 #	p 4	N87-27704 * #	p 72	N87-29867 * #	p 104
N87-26075 #	p 36	N87-27705 #	p 38	N87-29868 * # N87-29869 * #	p 104
N87-26081 * #	p 97	N87-27706 #	p 73	N87-29876 * #	p 104 p 162
N87-26082 * #	p 141	N87-27707 #	p 73	N87-29877 * #	p 102 p 138
N87-26083 *#	p 130	N87-27708 #	p 73	N87-29878 * #	p 138
N87-26085 * #	p 37	N87-27709 # N87-27712 *#	p 73	N87-29879 * #	p 104
N87-26086 *#	p 53	N87-27713 *	p 73 p 38	N87-29882 * #	p 83
N87-26097 * #	p 137	N87-27809 #	p 110	N87-29893 #	p 11
N87-26116 *#	p 98	N87-27865 #	p 159	N87-29898 * #	p 40
N87-26129 * #	p 98	N87-28186 #	p 81	N87-29899 * #	p 40
N87-26130 #	p 98	N87-28188 *#	p 81	N87-29914 * #	p 5
N87-26131 *#	p 98	N87-28260 #	p 103	N87-29915 * #	p 84
N87-26132 *#	p 98	N87-28405 #	p 99	N87-29916 * #	p 5
				·	

N87-29917 \* # p 84 N87-29930 \* # p 99 N87-29933 \* # p 74 N87-29938 \* # p 84 N87-30107 \* # p 11 N87-30220 # p 172 N87-30221 # p 172

# **AVAILABILITY OF CITED PUBLICATIONS**

#### IAA ENTRIES (A87-10000 Series)

Publications announced in *IAA* are available from the AIAA Technical Information Service as follows: Paper copies of accessions are available at \$10.00 per document (up to 50 pages), additional pages \$0.25 each. Microfiche<sup>(1)</sup> of documents announced in *IAA* are available at the rate of \$4.00 per microfiche on demand. Standing order microfiche are available at the rate of \$1.45 per microfiche for *IAA* source documents and \$1.75 per microfiche for AIAA meeting papers.

Minimum air-mail postage to foreign countries is \$2.50. All foreign orders are shipped on payment of pro-forma invoices.

All inquiries and requests should be addressed to: Technical Information Service, American Institute of Aeronautics and Astronautics, 555 West 57th Street, New York, NY 10019. Please refer to the accession number when requesting publications.

#### STAR ENTRIES (N87-10000 Series)

One or more sources from which a document announced in *STAR* is available to the public is ordinarily given on the last line of the citation. The most commonly indicated sources and their acronyms or abbreviations are listed below. If the publication is available from a source other than those listed, the publisher and his address will be displayed on the availability line or in combination with the corporate source line.

Avail: NTIS. Sold by the National Technical Information Service. Prices for hard copy (HC) and microfiche (MF) are indicated by a price code preceded by the letters HC or MF in the STAR citation. Current values for the price codes are given in the tables on NTIS PRICE SCHEDULES.

Documents on microfiche are designated by a pound sign (#) following the accession number. The pound sign is used without regard to the source or quality of the microfiche.

Initially distributed microfiche under the NTIS SRIM (Selected Research in Microfiche) is available at greatly reduced unit prices. For this service and for information concerning subscription to NASA printed reports, consult the NTIS Subscription Section, Springfield, Va. 22161.

NOTE ON ORDERING DOCUMENTS: When ordering NASA publications (those followed by the \* symbol), use the N accession number. NASA patent applications (only the specifications are offered) should be ordered by the US-Patent-Appl-SN number. Non-NASA publications (no asterisk) should be ordered by the AD, PB, or other *report number* shown on the last line of the citation, not by the N accession number. It is also advisable to cite the title and other bibliographic identification.

Avail: SOD (or GPO). Sold by the Superintendent of Documents, U.S. Government Printing Office, in hard copy. The current price and order number are given following the availability line. (NTIS will fill microfiche requests, as indicated above, for those documents identified by a # symbol.)

<sup>(1)</sup> A microfiche is a transparent sheet of film, 105 by 148 mm in size containing as many as 60 to 98 pages of information reduced to micro images (not to exceed 26.1 reduction).

- Avail: BLL (formerly NLL): British Library Lending Division, Boston Spa, Wetherby, Yorkshire, England. Photocopies available from this organization at the price shown. (If none is given, inquiry should be addressed to the BLL.)
- Avail: DOE Depository Libraries. Organizations in U.S. cities and abroad that maintain collections of Department of Energy reports, usually in microfiche form, are listed in *Energy Research Abstracts*. Services available from the DOE and its depositories are described in a booklet, *DOE Technical Information Center Its Functions and Services* (TID-4660), which may be obtained without charge from the DOE Technical Information Center.
- Avail: ESDU. Pricing information on specific data, computer programs, and details on ESDU topic categories can be obtained from ESDU International Ltd. Requesters in North America should use the Virginia address while all other requesters should use the London address, both of which are on the page titled ADDRESSES OF ORGANIZATIONS.
- Avail: Fachinformationszentrum, Karlsruhe. Sold by the Fachinformationszentrum Energie, Physik, Mathematik GMBH, Eggenstein Leopoldshafen, Federal Republic of Germany, at the price shown in deutschmarks (DM).
- Avail: HMSO. Publications of Her Majesty's Stationery Office are sold in the U.S. by Pendragon House, Inc. (PHI), Redwood City, California. The U.S. price (including a service and mailing charge) is given, or a conversion table may be obtained from PHI.
- Avail: NASA Public Document Rooms. Documents so indicated may be examined at or purchased from the National Aeronautics and Space Administration, Public Documents Room (Room 126), 600 Independence Ave., S.W., Washington, D.C. 20546, or public document rooms located at each of the NASA research centers, the NASA Space Technology Laboratories, and the NASA Pasadena Office at the Jet Propulsion Laboratory.
- Avail: Univ. Microfilms. Documents so indicated are dissertations selected from *Dissertation Abstracts* and are sold by University Microfilms as xerographic copy (HC) and microfilm. All requests should cite the author and the Order Number as they appear in the citation.
- Avail: US Patent and Trademark Office. Sold by Commissioner of Patents and Trademarks, U.S. Patent and Trademark Office, at the standard price of \$1.50 each, postage free. (See discussion of NASA patents and patent applications below.)
- Avail: (US Sales Only). These foreign documents are available to users within the United States from the National Technical Information Service (NTIS). They are available to users outside the United States through the International Nuclear Information Service (INIS) representative in their country, or by applying directly to the issuing organization.
- Avail: USGS. Originals of many reports from the U.S. Geological Survey, which may contain color illustrations, or otherwise may not have the quality of illustrations preserved in the microfiche or facsimile reproduction, may be examined by the public at the libraries of the USGS field offices whose addresses are listed in this Introduction. The libraries may be queried concerning the availability of specific documents and the possible utilization of local copying services, such as color reproduction.
- Avail: Issuing Activity, or Corporate Author, or no indication of availability. Inquiries as to the availability of these documents should be addressed to the organization shown in the citation as the corporate author of the document.

## **PUBLIC COLLECTIONS OF NASA DOCUMENTS**

**DOMESTIC:** NASA and NASA-sponsored documents and a large number of aerospace publications are available to the public for reference purposes at the library maintained by the American Institute of Aeronautics and Astronautics, Technical Information Service, 555 West 57th Street, 12th Floor, New York, New York 10019.

**EUROPEAN:** An extensive collection of NASA and NASA-sponsored publications is maintained by the British Library Lending Division, Boston Spa, Wetherby, Yorkshire, England for public access. The British Library Lending Division also has available many of the non-NASA publications cited in *STAR*. European requesters may purchase facsimile copy or microfiche of NASA and NASA-sponsored documents, those identified by both the symbols # and \* from ESA — Information Retrieval Service European Space Agency, 8-10 rue Mario-Nikis, 75738 CEDEX 15, France.

# FEDERAL DEPOSITORY LIBRARY PROGRAM

In order to provide the general public with greater access to U.S. Government publications, Congress established the Federal Depository Library Program under the Government Printing Office (GPO), with 50 regional depositories responsible for permanent retention of material, inter-library loan, and reference services. At least one copy of nearly every NASA and NASA-sponsored publication, either in printed or microfiche format, is received and retained by the 50 regional depositories. A list of the regional GPO libraries, arranged alphabetically by state, appears on the inside back cover. These libraries are *not* sales outlets. A local library can contact a Regional Depository to help locate specific reports, or direct contact may be made by an individual.

# ADDRESSES OF ORGANIZATIONS

American Institute of Aeronautics and Astronautics Technical Information Service 555 West 57th Street, 12th Floor New York, New York 10019

British Library Lending Division, Boston Spa, Wetherby, Yorkshire, England

Commissioner of Patents and Trademarks U.S. Patent and Trademark Office Washington, D.C. 20231

Department of Energy Technical Information Center P.O. Box 62 Oak Ridge, Tennessee 37830

ESA-Information Retrieval Service ESRIN Via Galileo Galilei 00044 Frascati (Rome) Italy

ESDU International, Ltd. 1495 Chain Bridge Road McLean, Virginia 22101

ESDU International, Ltd. 251-259 Regent Street London, W1R 7AD, England

Fachinformationszentrum Energie, Physik, Mathematik GMBH 7514 Eggenstein Leopoldshafen Federal Republic of Germany

Her Majesty's Stationery Office P.O. Box 569, S.E. 1 London, England

NASA Scientific and Technical Information Facility P.O. Box 8757 B.W.I. Airport, Maryland 21240 National Aeronautics and Space Administration Scientific and Technical Information Division (NTT-1) Washington, D.C. 20546

National Technical Information Service 5285 Port Royal Road Springfield, Virginia 22161

Pendragon House, Inc. 899 Broadway Avenue Redwood City, California 94063

Superintendent of Documents U.S. Government Printing Office Washington, D.C. 20402

University Microfilms A Xerox Company 300 North Zeeb Road Ann Arbor, Michigan 48106

University Microfilms, Ltd. Tylers Green London, England

U.S. Geological Survey Library National Center - MS 950 12201 Sunrise Valley Drive Reston, Virginia 22092

U.S. Geological Survey Library 2255 North Gemini Drive Flagstaff, Arizona 86001

U.S. Geological Survey 345 Middlefield Road Menlo Park, California 94025

U.S. Geological Survey Library Box 25046 Denver Federal Center, MS914 Denver, Colorado 80225

# **NTIS PRICE SCHEDULES**

(Effective January 1, 1988)

#### Schedule A STANDARD PRICE DOCUMENTS AND MICROFICHE

PRICE CODE	NORTH AMERICAN PRICE	FOREIGN PRICE
A01	\$ 6.95	\$13.90
A02	9.95	19.90
A03	12.95	25.90
A04-A05	14.95	29.90
A06-A09	19.95	39.90
A10-A13	25.95	51.90
A14-A17	32.95	65.90
A18-A21	38.95	77.90
A22-A25	44.95	89.90
A99	•	•
NO1	49.50	89.90
NO2	48.00	80.00

#### Schedule E EXCEPTION PRICE DOCUMENTS AND MICROFICHE

PRICE CODE	NORTH AMERICAN PRICE	FOREIGN PRICE
E01	\$ 8.50	17.00
E02	11.00	22.00
E03	12.00	24.00
E04	14.50	29.00
E05	16.50	33.00
E06	19.00	38.00
E07	21.50	43.00
E08	24.00	48.00
E09	26.50	53.00
E10	29.00	58.00
E11	31.50	63.00
E12	34.00	68.00
E13	36.50	73.00
E14	39.50	79.00
E15	43.00	86.00
E16	47.00	94.00
E17	51.00	102.00
E18	55.00	110.00
E19	61.00	122.00
E20	71.00	142.00
E99	*	*

<sup>\*</sup> Contact NTIS for price quote.

#### **IMPORTANT NOTICE**

NTIS Shipping and Handling Charges
U.S., Canada, Mexico — ADD \$3.00 per TOTAL ORDER
All Other Countries — ADD \$4.00 per TOTAL ORDER

Exceptions - Does NOT apply to:

ORDERS REQUESTING NTIS RUSH HANDLING ORDERS FOR SUBSCRIPTION OR STANDING ORDER PRODUCTS ONLY

NOTE: Each additional delivery address on an order requires a separate shipping and handling charge.

I. Report No.	Government Accession No.	3. Recipient's Catalog No	0.
NASA SP-7056 (06)			
4. Title and Subtitle		5. Report Date	
Space Station Systems		July, 1988  6. Performing Organizati	ion Code
A Bibliography with Indexes		6. Performing Organizati	ion code
		8. Performing Organizati	ion Report No.
. Author(s)		o. Fortonning organization	
		10. Work Unit No.	
. Performing Organization Name and Address		10. Work Offic No.	
National Aeronautics and Space Adr	di O-street en Creet Ne		
Washington, DC 20546		11. Contract or Grant No	<i>)</i> .
•			
		13. Type of Report and I	Period Covered
2. Sponsoring Agency Name and Address			
		14. Sponsoring Agency	Code
5. Supplementary Notes	ach and adited by Space Station Offic	e Langley Research Center	
	nch and edited by Space Station Offic	o, Eurigicy Flooduloit Conton,	
Hampton, Virginia.			
6. Abstract			اممناهمه اسما
This bibliography lists 1,133 reports	s, articles and other documents introd	acced into the MASA scientific	information to
information system between July	1, 1987 and December 31, 1987. Its	purpose is to provide neighborship	ng to evetem
the researcher, manager, and de	esigner in technology development	and mission design according	ing to system,
tata a salus analysis and docion str	uctural and thermal analysis and desi	ion. Structural concepts and co	nilioi systems,
alastropica advanced materials a	issembly concents, propulsion, and s	solar power salellile systems.	The coverage
includes documents that define m	ajor systems and subsystems, servi	cing and support requirement	is, procedures
and operations, and missions for	the current and future Space Station	1.	
AT Manda (Command by Authora/a))	18. Distribution	n Statement	
		ified - Unlimited	
Space Platforms			
Space Technology Experiments			
Space Erectable Structures			
•			
	20. Security Classif. (of this page)	21. No. of Pages	22. Price *
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 296	22. Price * A13/HC